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The Outlook

Grand Mastery

BRITISH aviation owes a great deal to our Royal Family, who have always shown great interest in all aspects of flying. His Majesty, who learned to fly in an Avro 504, maintains the King's Flight, in the aircraft of which he and the Queen and the Princesses have done much flying. Her Majesty has presented the Queen's Cup for model fliers, and last year she personally attended the Northern Heights Model Flying Club's meeting at Langley.

On Thursday of last week British aviation became still further indebted to the Royal Family, when Princess Elizabeth was installed as Grand Master of the Guild of Air Pilots and Air Navigators of the British Empire.

Her Royal Highness delighted all present at the reception held after the installation ceremony by revealing a quite remarkably wide and detailed knowledge of aviation matters, and for more than an hour she talked freely and with a complete absence of affectation with all manner of flying people, members of the Guild and their guests.

That Her Royal Highness should have accepted the Grand Mastership of the Guild is a compliment the sincerity of which cannot be doubted. And to those who know the Guild, and what it stands for, the compliment has been honestly earned. In these days of seeking after self-interest and self-advancement, it is good to have this fine body of men and women who are prepared to give of their best, not for personal gain but in order to serve the cause of aviation. This dedication was well brought out in the solemn promises given by the Master, Wardens and Assistants of the Court of the Guild at the installation ceremony. "I solemnly and sincerely promise that I will use every endeavour to promote the interests of aviation; that I will give all the assistance within my power to fellow members of this Guild, and charge myself with the welfare of all who occupy their business in the sky."

If there were more of that spirit abroad to-day the world would be a very much pleasanter place to live in.

Air Sailors

NO greater compliment could be paid to Naval Aviation by the Admiralty than the removal of the "A" from the curl of the rank-stripes on the sleeve. By implication, men of the Air Branch are now accepted unconditionally, and on equal terms, as sailors. Last week on this page the formation of the Royal Flying Corps from a Naval and a Military wing, and the subsequent break-away of the R.N.A.S., were recalled. Thus the two great air services of to-day—Naval Aviation and the Royal Air Force—might be regarded as of twin birth. Even so, the belief has persisted that, so far as their Lordships are concerned, the Air Branch has continued to be something of an *enfant terrible*. That this is untrue is now confirmed beyond doubt.

Not only is the Air Branch of the Navy to be absorbed into existing branches, but the status of its aircrews has been raised, and in future, pilots and observers will all be of commissioned rank. This recognition of the tremendous increase in the responsibilities of the captain of a modern military aircraft is, perhaps, overdue. The fact that the cost of a modern strike or reconnaissance machine approaches that of a fighting ship of a century ago has, possibly, had some bearing on the decision.

At the present time an officer of the Air Branch has neither the training nor the experience to take command of a ship should the emergency arise. It is to be hoped that in the future regular officers with a Dartmouth background who volunteer for flying duties (they will form a main source of aircrews) will be able to assume command both in the air and afloat, and so carry the policy of absorption or combination to its logical conclusion.

Beating the Bomber

RESOLVED to withhold such tactical information as might prove valuable to an enemy, the author of the major article in this issue was constrained to omit some significant observations. He was minded, for instance, to allude to the possibilities, under certain conditions, of the head-on attack—generally considered, by reason of the high rate of closure, prohibitively difficult and dangerous. For what were deemed good reasons he forbore to do so.

In the brief period since his study of fighter requirements was completed, published references to collision-course attacks by jet fighters have been noted in the British and American Press. A British report quotes figures for the approach speed and break-away distance of the Meteor during such an attack, and remarks that the manœuvre is most effective against B-29 bombers. *American Aviation*, on the other hand, describes the head-on attack as "impossible," since the closing speed requires visual sighting of the bomber outside of human sight limits. The height assumed in this instance is 40,000ft. This is appreciably greater than the normal operating levels of the B-29 type, but the much larger B-36 is credited with at least two twelve-hour flights at this altitude.

To *American Aviation* we further acknowledge the observation that, astonishing as it may seem, the Brabazon-sized B-36 can actually *out-manœuvre* an American jet fighter at 40,000ft. The explanation of this is not far to seek; with its "high-speed" wings, the fighter stalls out of anything more than a shallow turn, while the bomber, with its great wing area, and relatively low-span loading, can make reasonably steep turns without loss of control.

Without exception, American jet fighters are inferior in high-altitude handling qualities to comparable British types, amongst which the de Havilland Vampire is especially notable for its tractability at 35,000-45,000ft. It is common knowledge that tactical data of the utmost value have been forthcoming from affiliation exercises between Vampire and Meteor squadrons of Fighter Command and elements of the U.S.A.F. bomber force based in this country, and that the benefits of this co-operation (entailing only B-29 bombers) accrued more to ourselves than to the Americans. As a *quid pro quo* the R.A.F. might do well to offer a section or squadron of Vampires for high-altitude trials against B-36s and the latest types of American jet bombers.

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"Flight" photograph

THE GRAND MASTER ARRIVES. H.R.H. Princess Elizabeth was installed as Grand Master of the Guild of Air Pilots at a ceremony at Londonderry House last Thursday. The event is described on pp. 432-433.

FIGHTER REQUIREMENTS

With two 100-gall drop-tanks, as seen above, the Vampire 5 has a range of up to 1,145 miles.

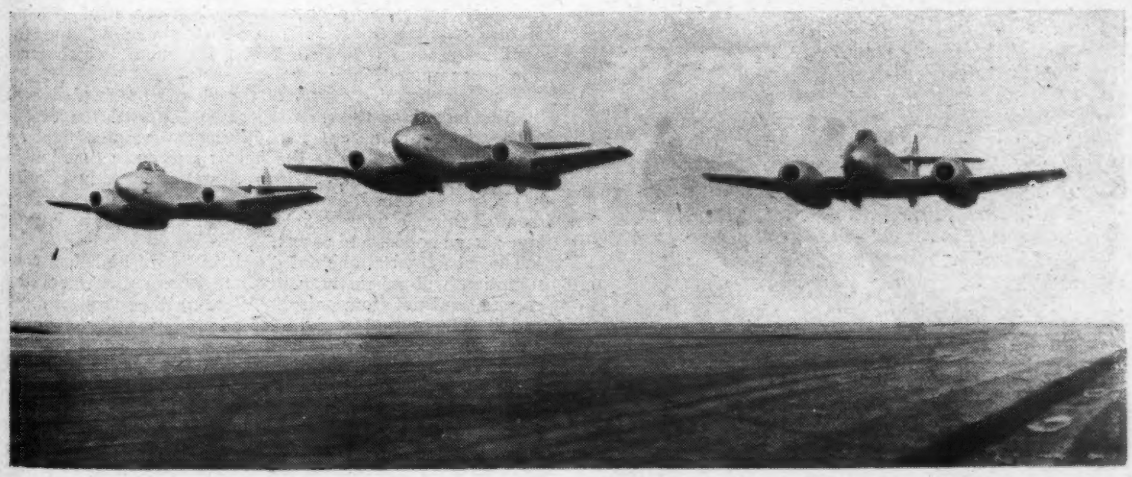
Performance : Handling : Armament : Tactics : Functions

By H. F. KING, M.B.E.

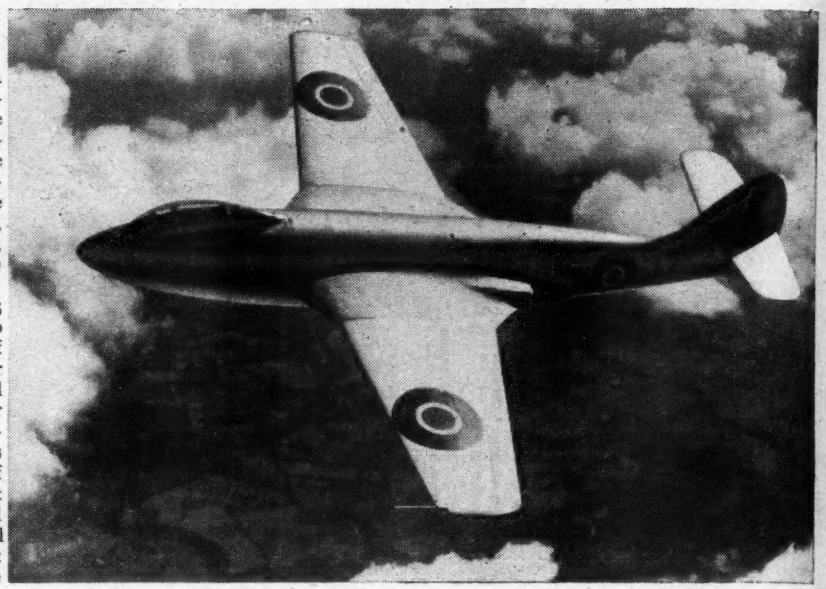
A THREEFOLD purpose underlies the following study—to present a realistic picture of the tasks now confronting fighter aircraft; to assess the operational qualities of current types; and to indicate the likely channels of development. The opinions advanced are not necessarily those of the Air Ministry or any Crown department and information from foreign sources is freely drawn upon to elucidate points which might otherwise be obscured by British security restrictions. Standard fighters of the Powers are briefly reviewed by way of introduction.

Britain's first jet fighters—the Gloster Meteor and de Havilland Vampire—were adopted by the Royal Air Force during the late months of the Second World War, and no more convincing proof of their merit could be adduced than their continued employment, after four years' service, in ever-increasing quantities and varieties. Their unique qualities and potentialities will later be examined in some detail, but it is appropriate to observe here that the Meteor, by virtue of its preponderance of thrust, is capable of very high speeds, and rates of climb unequalled by any other standard fighter. The Meteor, in fact, answers to the characteristically British formula of a home-defence intercepter, in which speed, climb and acceleration are predominant factors; it is nevertheless versatile enough to be used for low-level attack or photographic reconnaissance, although the R.A.F. is not at present employing Meteors for these purposes.

Itself an intercepter of great merit, the Vampire, at its present stage of evolution, is not the equal of the Meteor in maximum speed and rate of climb, especially at low and medium levels. Its particular virtues are those which stem from a low wing-loading and moderate thrust. Manœuvrability and stability—especially at height—are of a very high order, and in sweetness of control the Vampire admits no peer. Range and endurance, as demonstrated



Three Meteor 4s make a spectacular "display" take-off without the 180-gall ventral tanks normally fitted.



A novel turbojet installation endows the F.1040 with exceptionally long range.

by two Atlantic crossings via Iceland and Greenland, are exceptional, and Vampires can be safely operated from small airfields. As a fighter-bomber, the type again performs to advantage, while the success of the deck-landing Sea Vampire, already serving the Royal Navy, bespeaks tractability at low speeds as well as high.

In the Meteor 4 and Vampire 5 the R.A.F. to-day has two proven types of fighter, both of which are amenable to further development. Bearing in mind that speed, climb and other quantitatively expressed performances are in themselves grossly inadequate yardsticks of efficiency, it can be affirmed that the Service is well equipped with types of fighters to deal with any opposition which might arise now, or in the immediate future. The same, of course, applies to the numerous countries which have adopted the Meteor or Vampire.

The first American jet fighter to be placed in large-scale production was the Lockheed Shooting Star (F-80), another wartime design, but one in the development of which emphasis was placed on range and endurance. Climb and general manœuvrability of the type, as now in service, are

Fighter Requirements . . . . .

handicapped by a heavy wing-loading and relatively low thrust, though in rate of roll (one single factor in manœuvrability) the powered ailerons of the Shooting Star confer a certain advantage at low and medium levels. The common F-80 sub-types A and B are not remarkable for their speed, but the F-80C, having greater thrust, shows a real improvement in this respect and in time to height.

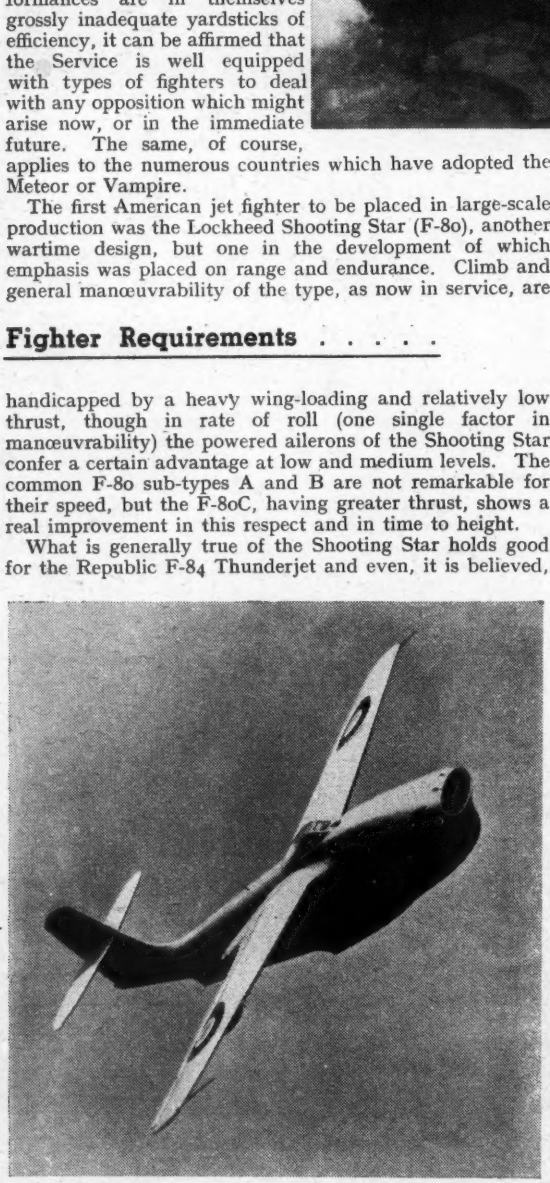
What is generally true of the Shooting Star holds good for the Republic F-84 Thunderjet and even, it is believed, for the North American F-86, now following that type into service. By virtue of its swept-back wing and tail surfaces, however, the F-86 is unmatched in level speed by any standard fighter. Squadron pilots are permitted to attain a Mach Number of 0.96, and supersonic speed has been achieved during experimental flying. The U.S. Navy is adequately equipped with medium-performance jet fighters in which the qualities of endurance and range are emphasized.

The characteristics of Soviet jet fighters remain enigmatical. Russia continues to employ a greater proportion of piston-engined fighters than does either Great Britain or the U.S.A., but these obsolescent machines have no place in the present discussion. Though the combat efficiency of the single-jet Yak 15, now operational, is as difficult to assess as that of any other Russian fighter, this type is certainly controllable enough to perform aerobatics in formation. In speed and climb, however—especially at height—the Yak is doubtless inferior to the Vampire and Meteor; nor is the twin-jet Mig likely to prove as formidable as the British machines.

Of the standard types to which allusion has been made in the foregoing summary, none is suitable in its present form for efficient operation at night or in bad weather, and each represents a compromise between strongly conflicting requirements. It is these requirements, and the qualities necessary to their better fulfilment, which must now be examined.

The demonstrated power of the atomic bomb, delivered by the fast, high-flying bomber, has stressed the urgent need for fast-climbing, hard-hitting intercepter fighters. Certainly, interception is the fighter's primary function in the R.A.F. to-day, though in war, and after air superiority has been established, circumstances may justify the employment of suitable fighters for the secondary duties of intruding, army support and escort.

The jet fighter's inherent disadvantage of high fuel consumption will normally necessitate interception from the ground, and not from patrol. Warning time may be short and it follows that rapidity of climb is the first requirement. A moderate wing loading and the greatest possible thrust are indicated, the former not only for its beneficial effect on take-off and rate of climb but for the advantage it confers in manœuvring to attack at high altitudes. Great thrusts are already available (the latest version of the Rolls-Royce Nene, for instance, delivers 5,500 lb static) but the advantage of some form of thrust augmentation is nevertheless

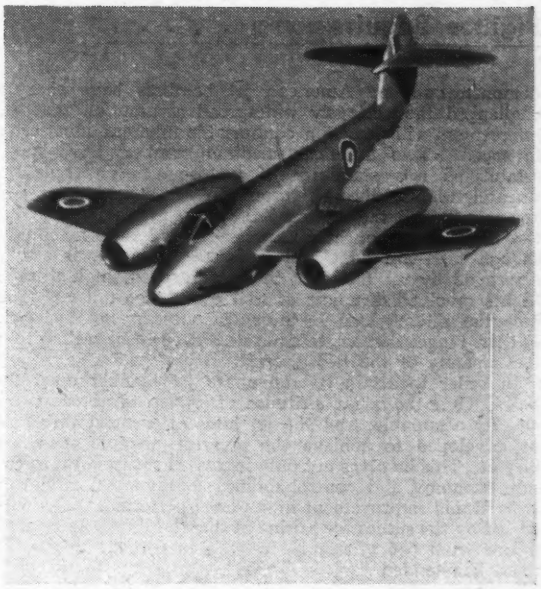


Unique in design and function — the 500 m.p.h. S.R/A1 flying-boat fighter.

being sought. The expedient likely to be favoured in this country is tail-pipe after-burning rather than the liquid-fuel rocket. The after-burner consumes standard turbojet fuel and though bulky, heavy, and having a formidable fuel consumption, appears to offer such a large increment of thrust for the short periods during which it is required that the design penalties it imposes should prove acceptable. A modern fighter employing after-burning is the Chance-Vought XF7U-1 Cutlass for the U.S. Navy.

By contrast, rocket fuels are expensive, difficult to store and highly vulnerable when carried by an aircraft, though the fuels for the rocket might well be exhausted by the time the intercepter closed with its quarry. Even with recourse to an auxiliary cruising rocket or intermittent periods of gliding, a pure-rocket machine, such as the German Me 163 which operated against massed Allied bombers in the closing months of the war, is limited to an effective endurance of but a few minutes. A combined turbojet and bi-fuel rocket unit was on trial in Germany during 1945.

America's first turbojet-cum-rocket intercepter has lately been completed. Built by Republic, this very highly specialized short-range machine (XF-91) has a single axial-flow turbojet and, built in at the tail, a battery of independent rockets. Rocket power is intended primarily for use on the climb and for closing on the enemy at high altitude, but can be used additionally to improve take-off. Such types as the XF-91 have the disadvantage of being difficult to operate in anything but fair weather by reason of their short endurance, lack of space for aids and handling characteristics in the circuit.



The air-brakes of the Meteor 4 are seen in action in this new Flight view.

Reference has already been made to the excellent rate of climb of the Meteor, which, with the Derwents running at combat rating, reaches 10,000ft in 1.5 min; 30,000ft in 6.4 min; and 40,000ft in 11.8 min, surpassing in this respect all current marks of Vampire and foreign contemporaries. The Supermarine Attacker (Nene) has likewise demonstrated exceptional climbing ability to medium altitudes, the declared time of climb to 20,000ft being 3.6 min, and to 30,000ft 6.17 min. All these figures, be it noted, apply to the aircraft without external tanks, a condition in which the Meteor's endurance is much less than that of the Vampire with internal fuel only. So greatly does the fitting of a 180-gallon belly tank detract from the Meteor's performance, however, that on this basis of more nearly comparable endurance there is little to choose between its climb to 40,000ft and that of the Vampire 6 to the same height with no external tanks. Up to a height of 30,000ft the Meteor's superiority is retained in spite of the belly tank.

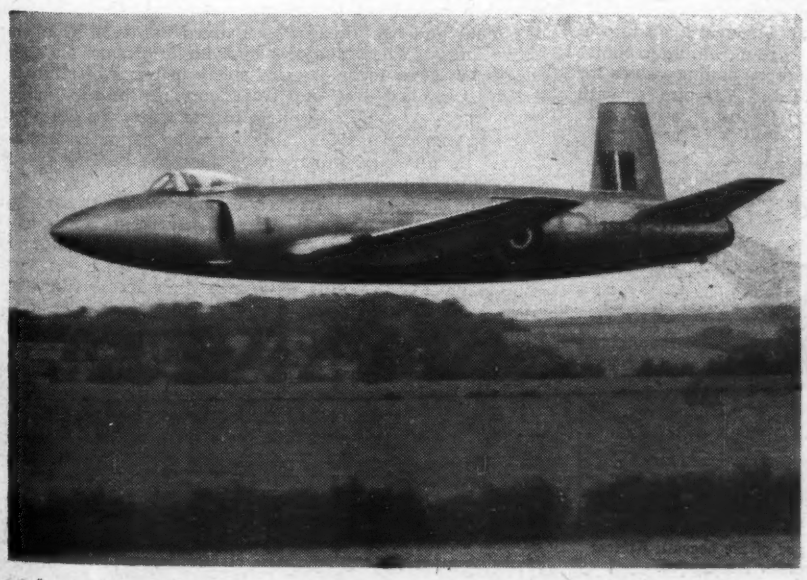
The Meteor's *forte* being high-speed interception, external tanks will not always be needed, so that full advantage can be taken of its exceptional climbing powers during daylight and fine weather.

Experimental Ascents

Indicative of the Meteor's ability to translate increased thrust into terms of climb was the recent ascent to 40,000ft in 7.31 min by an experimental machine of this type powered by two Metrovick Beryl axial-flow turbojets of 7,900 lb total static thrust. Of even greater significance was a sustained climb by a Ghost-Vampire, of standard span, to 56,500ft in 23 min 50 sec—a performance unmatched by any jet fighter in the world, and the more remarkable in having been recorded a year ago.

Climbing performances of this order emphasize the importance of rapid take-off and acceleration to climbing speed, qualities which, in their turn, demand a shorter interval between the order "scramble" and the moment the fighter moves off down the runway. The pilot will be seated ready in his cockpit at the head of the runway, his gyro instruments already running. Instructions will be delivered by telephone laid on to his aircraft. Having started up the turbojets, he will be airborne in little more than half a minute.

Having attained the bomber's height the intercepter must exploit its speed and manœuvrability to position itself most favourably for the kill. While standard jet fighters have a sufficient margin of speed to deal with current piston-engined bombers of the Superfortress class, recent



In production for Naval Aviation, the Attacker attains 590 m.p.h.

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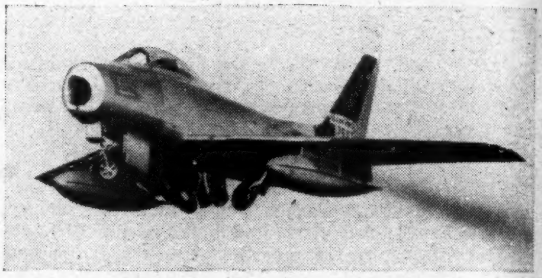
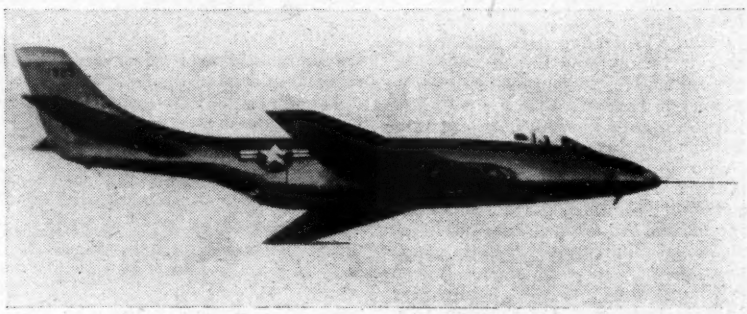
demonstrations by American jet bombers have sharply challenged the curiously widespread assumption that jet intercepters will possess a comfortable inherent superiority in speed. Two American medium bombers have lately established new standards of performance on transcontinental flights, the Northrop XY-49 having averaged 502 m.p.h. and the Boeing XB-47 607 m.p.h. Moreover, the belief, so frequently expressed, that such machines, though fast, are hopelessly deficient in range, is surely disproved by the fact that these high-speed, high-altitude flights involved distances of well over 2,000 miles. The potential military load for these distances was not declared, but the ranges demonstrated are believed to be well within the capacity of the two aircraft.

In order to attain its range the jet bomber must fly high. Over-the-target altitudes of 35,000 to 40,000ft are already attainable, and the jet intercepter must therefore be developed to achieve the greatest possible speed *at height*. This involves not only increased thrusts but, to ensure economy and controllability, aerodynamic advances also. Rapid improvement in sea-level performance, as witnessed by the successive raising of the world's absolute speed record from 606.25 m.p.h. in 1945 to 670,981 m.p.h. in 1948, has tended to divert attention from the sharp falling-off in speed with increasing height observed in current jet fighters. This loss may result from decreased thrust or, where thrust is sufficient, from Mach limitations. Apropos of thrust, a typical British turbojet, the Rolls-Royce Derwent 5, delivers 2,880 lb at 500 m.p.h. at sea level, and 1,425 lb at the same speed at 30,000 ft. By taking fuller advantage of ram effect, the Goblin, with its single-sided impeller, maintains its thrust to a greater degree. Makers' figures for the Meteor 4 (two Derwent 5s), flying at combat rating with no external tanks, show a top speed of 585 m.p.h. at sea level; 569 m.p.h. at 20,000ft; 545 m.p.h. at 30,000ft; 518 m.p.h. at 40-000ft; and 493 m.p.h. at 45,000ft. The corresponding values for the Vampire 6 (export version of the Vampire 5, with Goblin 3) are 548 m.p.h. at sea level; 534 m.p.h. at 20,000ft; 513 m.p.h. at 30,000ft; 489 m.p.h. at 40,000ft; and 480 m.p.h. at 45,000ft.



The North American F-86 Sabre, now in production, can carry two drop-tanks under the thin swept-back wing.

It will be seen that at extreme altitudes the Vampire, though still the slower machine, has tangibly reduced the Meteor's margin of superiority—a gain attributable to the characteristics of the Vampire airframe and to the high "installed efficiency" of the Goblin. Developed for the attainment of higher Mach Numbers, and with increased thrust, the Vampire promises speeds which, if not, perhaps, commensurate with the improved climbing powers already exemplified by the performance of the Ghost-Vampire, should be ample to maintain its enviable position among high-altitude fighters.



Believed to be one of the fastest American prototypes, the twin-jet McDonnell "penetration" fighter has a high degree of sweep-back, well shown in this view.

The world's fastest fighters at present are the North American F-86 and later prototypes for the U.S.A.F., all with highly loaded swept-back wings. Low-level speeds approaching 700 m.p.h. have been claimed for the F-86, but specific data, especially concerning performance at height, are withheld. With sufficient thrust the type is probably capable of level-flight speeds greater than that of sound, and has already been dived at Mach Numbers above unity. The value of a high limiting Mach Number is not, however, to be assessed solely in terms of ultimate speed. Implied freedom from compressibility trouble means more accurate shooting and less worry for the pilot who, fighting at great heights, may be seriously handicapped by the narrow margin between the limiting speed of his aircraft and its stalling speed.

Given sufficient speed, the intercepter must be manœuvrable enough to be quickly and accurately positioned for its attack. Manœuvrability is a function of wing loading, span loading and power loading. A low wing-loading is desirable to permit high accelerations in turns, and low span and power loadings are beneficial both to rate of turn and rate of climb. Here, in fact, is rooted one of the designer's most intractable problems. Should he provide too small a wing area his fighter may prove powerless to administer the *coup de grace* before the bomber has discharged its load; on the other hand, should he allow too generous an area, top speed will be affected and structural strength may suffer. The delta wing-form may lighten his worry on this score.

With the bomber flying at, say, 550 m.p.h. at 40,000ft, the fighter is likely to be severely restricted in its tactics. Attack from astern may be the only practicable method. If flying near its ceiling, at a coarse angle of incidence,

The two-seat Northrop F-89 Scorpion, one of the heaviest fighters yet built, is intended for all-weather interception.

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the fighter might need to open fire from a level below the bomber.

The possibility must always be considered that, following the German example, an enemy may operate small numbers of highly specialized bombers or reconnaissance machines at appreciably higher levels than his standard types. It is prudent, therefore, to consider the service ceiling (height at which rate of climb has dropped to 500 ft/min) attainable by the defending fighters. Makers' performance data show that the Meteor 4 has a service ceiling of 44,500ft, that is 2,200ft higher than that of the Vampire 5, but 1,000ft less than the Vampire 6 with Goblin 3.

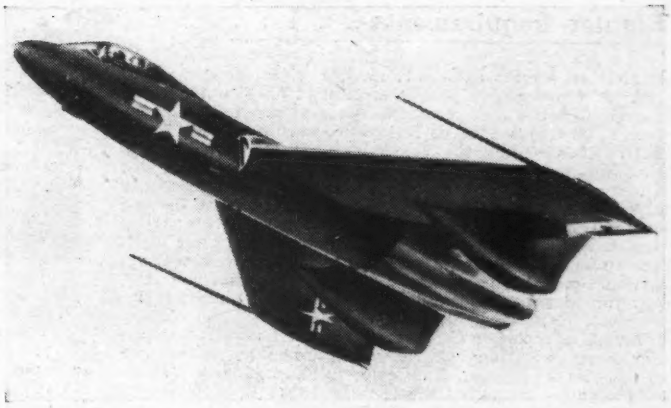
Such figures, however, are solely of academic interest unless related to the handling qualities at high altitudes, and here the Vampire, with its lighter wing loading, possesses the advantages of a smaller turning circle and general manœuvrability, though in excess of 350 knots A.S.I. and above 25,000ft the Meteor equals the Vampire in rate of roll, and is superior to it in acceleration. The virtue of a low wing-loading is, none the less, apparent, and the Vampire's potentialities as an ultra-high-altitude fighter were firmly established in March last year by Mr. John Cunningham's world-record climb to 59,492ft in a Ghost-Vampire, the span of which had been extended by 8ft.

Interception at 40,000ft and above is by no means a simple sequence of climb, turn, close and fire. The utmost physical fitness and powers of concentration are demanded of the pilot if he is to exploit to the full the qualities of his machine. He is beset by incidental difficulties—that, for instance, of sighting his quarry and determining its course. Cloud is seldom encountered above 35,000ft, so visibility is generally fair, and, if the fighter pilot knows more or less where to look for his target, and assuming that his field of view (as from the Meteor, Vampire, Hawker P.1040 and other British fighters) is good, his eye may pick it up ten miles or so away. It has been found, however that at 35,000-40,000ft, at ranges above five miles, the human eye is incapable of judging distance and relative heading with any degree of accuracy. At great heights the glare of the sun is very trying, but while good tinted glasses are valuable in minimizing glare, they may have the disadvantage of restricting the pilot's vision. Should radii of turn and operational speeds increase, the A.I. radar, with its attendant penalties in weight and complication, may prove as indispensable by day as by night.

The "closing-in" phase of the attack is obviously critical. Sound instruction in aircraft recognition will continue to be imperative, and to remove the possibility of a fighter, flying on instruments, pursuing and attacking a friend some means of air-to-air identification will be required.

At the operating levels of Superfortress-type bombers (30,000-35,000ft) greater latitude is allowed in selecting the method of attack. These heavily armed piston-engined machines will frequently operate in groups, at relatively low speed, and the fighters will seek to disrupt their formation, thereby eliminating the possibility of mutual defensive fire and allowing stern or quarter attacks to be made in greater safety.

Though many and varied methods of attack have been tried against medium-altitude bombers since jet fighters came into service, no more than two or three are likely to prove effective with present gunsights and without "g" suits. The need for "g" suits, be it said, has not yet become apparent in this country, though evidently they will be necessary if future types of fighter are to be flown in combat to the limit of their capabilities.



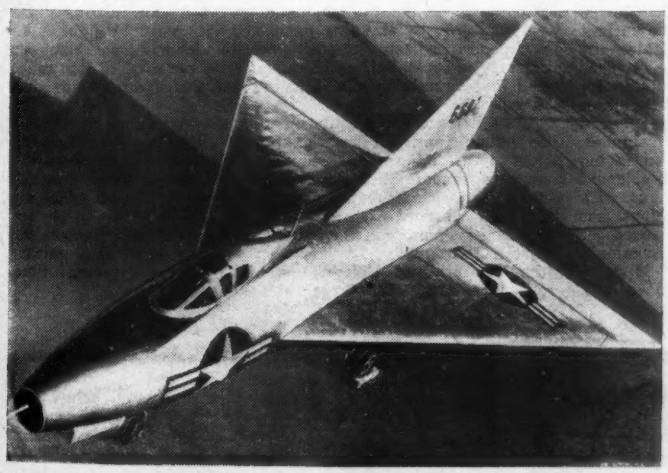
Designed to attain high Mach numbers, the Chance-Vought Cutlass naval fighter is fitted with after-burners in the tail-pipes of its two axial-flow turbojets.

Armament

The most proficient warning and reporting system and the fastest climbing and most tractable intercepters are, obviously, of little value if, having brought their armament to bear, they are incapable of making a quick kill. Now that a few seconds may literally mean the difference between the complete destruction of a city and its survival, the effectiveness of armament has become a more vital consideration than ever before. For the present, British fighters are all similarly armed with 20mm Hispano guns. The same fire power is available on certain types of American fighter, though there is an understandable reluctance on the part of the Americans to depart from the multiple 0.5in guns which gave such excellent service in the last war. The U.S. Navy has lately introduced a 0.6in weapon, and the Soviet Air Force retains the 12.7mm (½in) gun as an auxiliary to ordnance of 20 and 23mm calibre; but in the R.A.F. the 20mm Hispano is unlikely to be challenged by guns of smaller bore. Rather, in the light of German experience, heavier guns (e.g., of 30mm) may be adopted. High muzzle-velocity and density of fire are vitally important, because the relatively large turning-radius of the fighter at extreme heights, and the difficulty experienced by its pilot in sighting a lone bomber, may so elongate a conventional quarter attack that the fighter may need to open fire from 1,000 yards or more. The low air-resistance at great height, by allowing a flatter trajectory, effectively increases potential accuracy of fire.

For the dispersal of formations, and for attacks on single super-heavy bombers, batteries of rocket projectiles or even small air-launched guided missiles (e.g., the German X4) may prove effective. The most careful fairing or, preferably, internal stowage, will be demanded to avoid reduction of the fighter's critical Mach number. Proximity-fused large-calibre shells or rocket projectiles are further possibilities, the R.P., of course, being greatly superior in destructive power for a given weight, though less accurate and having a longer time of flight.

The design of gun sights, in which Britain is unexcelled, must keep pace with weapon development, and radar must play an increasing part in sighting. Aerodynamic considerations will continue to prejudice the pilot's field of vision. A



Although developed for research, the delta-wing Convair 7002 is an indication of the probable appearance of future high-speed military aircraft.

Fighter Requirements . . . . .

retractable sight would enhance his view for "search."

As to the "passive protection" of jet fighters, the writer can do no better than record the observations of Air Commodore F. R. Banks, C.B., O.B.E., who, when questioned at the R.U.S.I. concerning the vulnerability of the turbojet, said that from the military point of view it could be assumed that a fairly low flash-point fuel would be used. Apart from this, if a jet engine were hit in the combustion chambers at the rear end, near to the turbine, a catastrophic fire was likely; therefore, it would be necessary to place armour round these parts. The turbojet, he thought, lent itself to fairly easy armouring; it would probably be necessary to armour the unit in belts—e.g., round the chambers and turbine—and let the jet pipe take care of itself.

An official report on U.S. Navy air research records that particular stress is being placed on the armouring of turbojets against battle damage. The report further alludes to the use of composite armouring materials and the development of fibre-fabric body armour for aircrews.

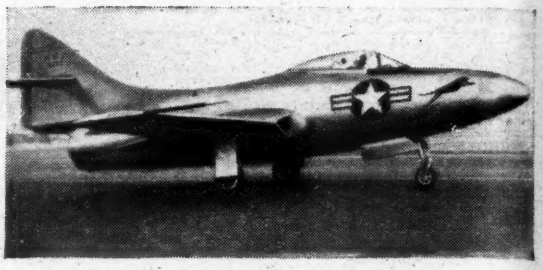
Types of fighters hitherto considered have been single-seaters, unsuited for efficient safe operation at night or in bad weather; but situations can be foreseen in which conditions of weather or light would render such aircraft quite impotent in the face of a determined bomber attack. Thus the requirements for the day fighter and night fighter are merging and all-weather fighters must be developed without delay for the R.A.F. As an interim measure for the U.S. Army an order has been placed for a two-seater version of the Lockheed F-80, closely related to the trainer variant, but carrying radar equipment, and there would appear to be no reason why the Meteor 7 should not be similarly adapted. Such a modification would inevitably suffer handicaps in comparison with, say, the Northrop F-89 Scorpion, specifically developed as an all-weather fighter, and now going into quantity production for the U.S.A.F.

Blind Firing

The concept of the modern all-weather day-and-night fighter is a machine which retains to the greatest possible degree the qualities of the short-range single-seater intercepter while having the advantages of longer endurance, more elaborate navigational aids, and radar for rendering interception more certain. Such a machine—a two-seater—might be equipped for blind-firing, the radar response being projected on to the windscreen in front of the gunsight, and the pilot having simply to follow the "blip."

Obviously, a fighter with these attributes must be appreciably larger and heavier, and inferior in several aspects of performance to the single-seat daylight intercepter, total abandonment of which would be very ill-advised. This type must be preserved as an insurance against the fastest and highest-flying of the enemy's bombers likely to be encountered in daylight. Simple radar and a navigational aid could greatly extend its usefulness, but in the attainment of speed and climb the design must be uncompromising.

The need for structural standardization, so apparent in war (and, indeed, in the impecunious days of peace), will demand adaptability, though this requirement must never be allowed to prejudice unduly the operational effectiveness of the variant aircraft. A version of the night and all-weather fighter airframe, for example, with increased internal tankage in place of the second crewman and radar, might prove suitable for short/medium-range bomber escort. Only tactical bombers could be convoyed to the limit of their endurance, but types of longer range might be accompanied for certain distances, which, their crews would agree, would be preferable to having no escort at all. The U.S.A.F. having achieved such splendid results in its wartime escort operations with Mustangs, Thunderbolts and Lightnings, has pursued the development of specialized jet "penetration" fighters, the best example of which is the McDonnell XF-88, with a potential speed of 650 m.p.h. or more, and a rumoured range in excess of 2,500 miles.



The Grumman Panther, with a Pratt and Whitney-built Rolls-Royce Nene, is an American naval fighter comparable with the Hawker N.7/46. A two-seat version has been considered.

Compared with the earliest models of Meteor and Vampire, the range and endurance of current Service-type fighters have been greatly extended. Thus, with full external tankage, the Meteor 4 has a range of 950 miles at 30,000ft. Cruising at the same height, the Vampire 6 will fly for 1,220 miles and the Attacker for 1,100 miles. By virtue of a split jet-pipe, the Hawker P.1040 and N.7/46 fighters have a greater internal fuel capacity than has any comparable British type and, with the addition of two 90-gallon drop-tanks, should have a range almost equal to that of the piston-engined Sea Fury.

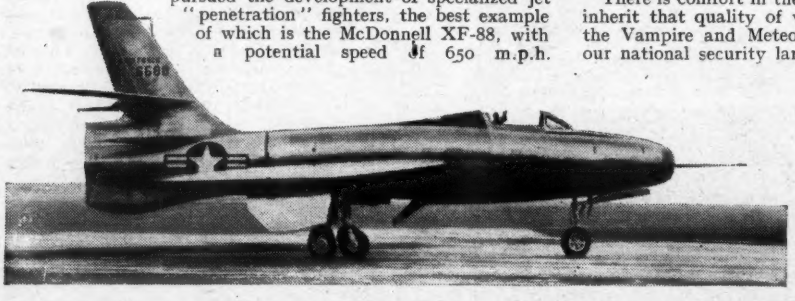
Attack and Escort

Once more to consider future needs and possibilities, it would appear that a second variant of the night and all-weather fighter would have the makings of an excellent ground-attack aircraft. A single-seater, similar to the proposed escort fighter, this model would carry supplementary tankage and, in view of its special application, might be provided with "cell" tanks, a hit on which would not necessarily mean total loss of fuel. The weight of armament possible can be gauged from the war load of the Vampire fighter/bomber: four 20mm guns with 150 r.p.g., eight 60-lb R.P.s and two 500-lb bombs, or, as an alternative to the composite bomb/rocket load, two 1,000-lb bombs—a formidable "punch" for a machine of only 12,390 lb gross weight. Guns of 30mm or larger calibre and greatly improved R.P.s, up to 1,000 lb or more in weight, could be readily disposed in the hypothetical attack machine. Speed would be valuable for the approach to and retirement from the target, but bumpy weather at the extremely low levels at which the type would be required to operate would inevitably prove a limiting factor. The greatest problem, however, in the development of the future jet-propelled fighter/bomber is likely to be the perfection for service use of a practical navigating aid.

A further variant of the jet-propelled night-and-all-weather fighter, closely akin to the adaptations for escort and ground-attack, might be an intruder. It must be admitted, however, that a piston-engined or turboprop aircraft promises better service in this rôle for some years to come, for the intruder, taking advantage of the limitations of radar at low altitude, and opposed only by standing patrols of fighters or by light A.A., will penetrate deep into enemy territory at low level, harassing aircraft and installations as opportunity permits, so that range and manœuvrability are likely to prove of greater value than speed.

As a defence against the intruder the long-range fighter will be valuable and will doubtless further extend its field of usefulness to anti-flak and anti-shipping strikes, and to photographic reconnaissance. Such missions, it must again be emphasized, are secondary considerations in the design of aircraft which are primarily charged with the destruction of the enemy *in the air*.

There is comfort in the belief that future British fighters will inherit that quality of versatility which has so distinguished the Vampire and Meteor, upon which, at the present time, our national security largely depends.



Reverse-tapered wings and built-in rockets are two unfamiliar features of the radical Republic XF-91 interceptor.

HERE AND THERE

Royal Visit

DURING their visit to Northern Ireland next month, Princess Elizabeth and the Duke of Edinburgh will visit the Short Bros. and Harland, Ltd., factory at Belfast. The Princess will name the first of four Solent flying-boats on order for Tasman Empire Airways, which are to be used principally on the Australia-New Zealand portion of the Empire routes.

Light-aircraft Radio

AMALGAMATED WIRELESS, of Australia, has produced the Airmite two-way radio set, which is said to fit in a 4in cube, with a power unit occupying a space of 4 × 4 × 7in. Permitting pilot-to-passenger communication, the set incorporates VHF, weighs 9½ lb and has a range of 30 miles at 3,000ft and five miles at sea level.

South African Navigation Aids

THE Civil Aviation Division of the South African Department of Transport has ordered two Marconi ABAS beam approach installations. First airfields to be equipped with the system—which provides glide-path guidance as well as beam approach—will be Palmietfontein (Johannesburg) and Wingfield (Cape Town).

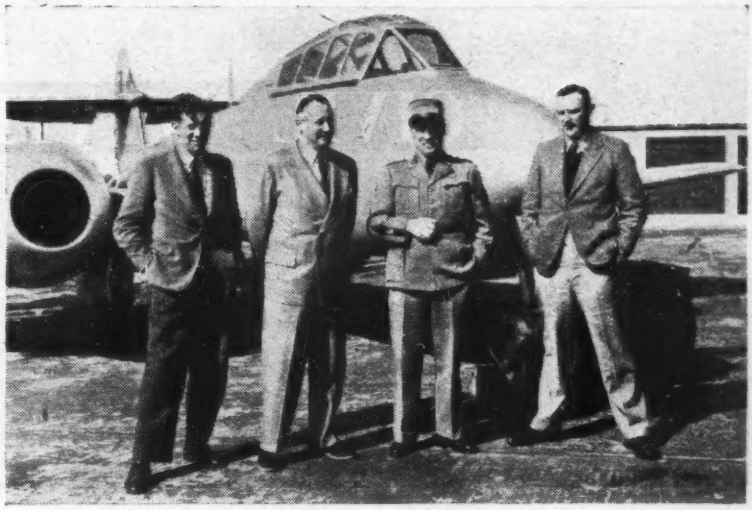
Industrial Gas Turbines

A COMMITTEE of 23 has been established by the Ministry of Supply to review and encourage industrial exploitation of the gas turbine. The chairman is Sir William Stanier (chief mechanical engineer, London Midland Region, British Railways), and among the members are A. Cdre. Sir Frank Whittle, Dr. H. Roxbee Cox, Capt. (E.) Luby, R.N., and Mr. H. Constant.

New Records

THE Fédération Aéronautique Internationale announces that Mr. John Derry's flight from London to Rome on November 4th, 1948, has been homologated as a British national point-to-point record. Mr. Derry established the record in a D.H. Vampire 5, flying for 2 hr 50 min 40 sec at an average speed of 313.45 m.p.h.

Light aircraft records are now classed according to weight in place of the previous engine capacity limitations. The first straight-line distance record in the 1,001-1,750 kg (2,200-3,870lb) category has been won by Capt. William P. Odom, with his 2,407-mile flight in a Beechcraft Bonanza from Hawaii to Oakland, California, on January 13-14th, 1949. Subject to official confirmation, Capt. Odom has since broken his own record with a second flight of nearly 5,000 miles.



INSTRUCTIONAL INVESTIGATION: Col. W. Frei, test pilot of the Swiss Air Force, recently visited the Gloster works and flew—with aerobatics—the Meteor 7 trainer. In this photograph are (left to right) Mr. R. Dryland (Gloster test pilot), Mr. R. F. G. Carse, (sales manager), Col. Frei, and Mr. T. Martindale (Rolls-Royce, Ltd.),

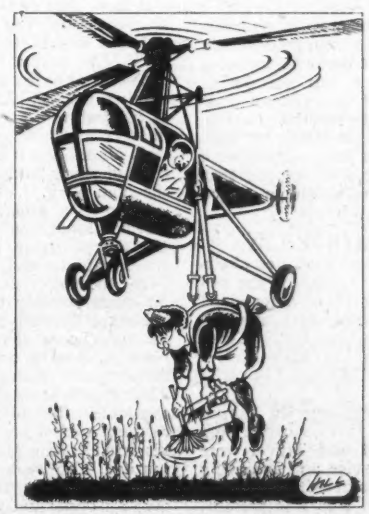
Keep Off the Grass

THE Borough Council of Beckenham (Kent) recently decided to seek Home Office approval for bye-laws to prohibit the flying of all power-driven model aircraft in corporation parks and recreation grounds.

U.S. Bomber Re-shuffle

IT was reported from Washington last week that the U.S. Air Force has cancelled an order for 43 Boeing B-54s, and that the cost will be diverted to new orders for additional Convair B-36s and Boeing B-47 jet bombers. The B-54, a later variant of the B-50, has "compound" engines, with variable-discharge turbines.

With the order for 36 more B-36s, the U.S.A.F. will have a total of about 160 of the largest-size aircraft delivered or on order. Two B-47s have been delivered and the original production order for 10 machines has been increased to 15.



"The helicopter is of particular valu . . . . for crop-dusting"

Something to Declare

FLOWN from Hatfield (where special Customs clearance was obtained), the first two of the 75 de Havilland Mk. 6 Vampires ordered for the Swiss Air Force have been delivered. In the hands of Messrs. Geoffrey Pike and Pat Fillingham, they reached Emmen, near Lucerne, in just under an hour. The Swiss order followed satisfactory experience with four Mk. 1 Vampires.

Permanent Withdrawal

CIVIL and R.A.F. Hythes and Sunderlands, which were taken out of service with the Air Lift last December because of the risk of ice formation on Havel Lake, will not rejoin the operation. It is reported that a high-level conference in London has decided that cost and organization are not justified by the tonnage carried. The flying-boats last year completed over 1,350 sorties with the Air Lift.

News in Brief

RACES organized by the British Motor Cycle Racing Club at Dunholme Lodge aerodrome, Lincs., yielded £1,712 for the R.A.F. Benevolent Fund.

* * *

To commemorate the 40th anniversary of the discovery of the North Pole by Admiral Peary, an aircraft of the U.S.A.F. dropped the Stars and Stripes over the Pole on April 6th.

* * *

The Photographic Survey Corporation, Canadian air survey associate of the Hunting Group, recently announced the purchase of all existing contracts, aircraft and laboratory equipment of the Aerial Surveys Division of Canadian Pacific Airlines, Ltd.

* * *

An attempt by a Czech pilot, Mr. Ladislav Marmol, to set a new single-seat sailplane endurance record on April 5th was foiled by a change of atmospheric conditions. Flying from Dunstable, he was in the air for 17 hr 24 min.

CIVIL AVIATION NEWS

I.C.A.O. Discusses Airworthiness: Charter Firms and Scheduled Services

NEW VINTAGE: The SE 2010 Armagnac, first of 25 for Air France transatlantic service, seen during its first flight, on April 2nd. Comparable with the Stratocruiser, it is likewise powered by Wasp Majors.

I.C.A.O. AIRWORTHINESS CONFERENCE

AT the third session of the Airworthiness Division of I.C.A.O., which, attended by delegates from 13 Member States, recently concluded in Montreal, considerable progress was made in the task of establishing a code of airworthiness requirements applicable to all sizes of transport aircraft. At previous meetings requirement for larger aircraft (Category A) had been discussed, and this session was devoted to the resolution of outstanding matters in Category A, and to the development of requirements for smaller transports.

A proposal was made by the United Kingdom that climb requirements should be based on a method developed by Boscombe Down. This was accepted, and it was also agreed that Member States should study the details with a view to making a comprehensive revision eighteen months hence. A second British paper, prepared by the A.R.B., in consultation with other interested bodies, outlined a complete set of performance requirements consistent with the Boscombe Down method. It was hoped that it would assist States in their study prior to agreement in detail.

Type tests and other requirements for turbine engines were discussed, and proposals submitted by the United Kingdom were adopted without material technical alteration.

International standards were agreed for small passenger transport aircraft (Category D, limited to 12,500 lb). In most respects the Category A requirements apply directly, but to permit the use of single-engined types, requirements for performance with an engine inoperative are excluded. To recompense for the greater likelihood of forced landing, a stalling-speed limit of 56 m.p.h. is imposed, and operations confined to V.F.R. day flights only.

An intermediate transport aircraft (Category C) was discussed. The British view was that such a category should cover the small or medium twin, in which performance with one engine failed is provided for en route, but not during take-off or initial climb. Many aircraft of this general class are flying to-day with very satisfactory safety records. Certain States, however, questioned the wisdom of providing for such aircraft in future, and sought to limit their use. The upshot was that, by a small majority, agreement was reached that Category C should be limited to a maximum weight of 12,500 lb, and a stalling speed not exceeding 65 m.p.h.

MEMORIES OF IMPERIAL AIRWAYS

MOST of the surviving directors and two of the three chairmen (Sir George Beharrell and Lord Reith) of the old Imperial Airways organization were among those entertained by B.O.A.C. to a luncheon to mark the twenty-fifth anniversary of the incorporation of Imperial Airways, Ltd. Those present included 20 members of the Twenty Five Club—veterans who had served for 25 years with B.O.A.C., Imperial Airways and its constituent companies.

Sir Harold Hartley (the chairman), in welcoming the guests, recalled the early days of airline flying in this country, back to the time when, in 1919, Air Transport and Travel were operating their Hounslow to Le Bourget service and achieving a regularity of 96 per cent without radio and with very few instruments. (Sir Frederick Handley Page, who was present, has since pointed out that Handley Page Transport shared the honour.)

Sir Harold caused laughter by his quotation of the Hambling Report, which, in 1923, recommended the amalgamation of the four companies then operating cross-Channel services into a £1,000,000 combine. "The Government," the Report had said, "should not exercise any direct control over the activities of the company, other than by the appointment of directors."

A photograph taken at the luncheon appears on p. 426.

B.E.A. TO THE RUHR

ON Monday, April 4th, British European Airways started a new service through the Ruhr, the first civilian service for ten years. Operated with Viking aircraft, five return flights a week are made, leaving Northolt on Mondays, Tuesdays, Wednesdays, Thursdays and Fridays at 1604 hr B.S.T. and arriving in Dusseldorf at 1755 and continuing to Hamburg, which is reached at 1915. The return flights are made on Tuesdays, Wednesdays, Thursdays, Fridays and Saturdays and leave Hamburg at 0720 hr, calling at Dusseldorf at 0915 and reaching Northolt at 1115. Fares from London to Dusseldorf are £10 single and £18 return, and from London to Hamburg £14 12s single and £26 6s return.

CORPORATIONS AND THE FLYING BOAT

READERS will be aware of *Flight's* enthusiasm for the flying-boat type of aircraft, and when the proposed amalgamation of British South American Airways and British Overseas Airways was announced we felt a good deal of uneasiness about the possible effect of the merger on the future of the flying boat. During a recent chat we were, therefore, very glad to learn from Sir Miles Thomas, who will officially become chairman of B.O.A.C. on July 1st, that he shares our enthusiasm (and that of the passengers) for the flying boat. He feels that the sea is our heritage, and that to start a voyage from water is to a Britisher the most natural thing in the world.

Sir Miles had an opportunity recently to test for himself the pleasures of flying the African route in a Solent, and he greatly admires this aircraft type and its crews. The scenery is full of interest to the passengers, and the machine is one of the most comfortable in the world, giving freedom to get up and walk about, and to stand in the promenade and look down upon the unfolding landscape, the view of which is unobstructed by the high wing.

There is a general impression that when the Handley Page Hermes landplane goes into service on the Springbok route, the Solent flying boats will be withdrawn. This will not necessarily be the case; if the boats continue to be popular with the travellers, the Solent service will be continued, although possibly the frequency may be reduced.

Future first-class air travel will, Sir Miles considers, cater for two classes of travellers; the passenger who is sent out by his firm to settle some very urgent business, and to whom cost is relatively unimportant while time is extremely valuable. That type will obviously travel by the fastest type of aircraft available. The other class of passenger is the man who is not in quite such a great hurry, and who will in many cases bring his family along and combine business with a pleasant holiday journey. To such travellers the flying boat will appeal on account of its great comfort, and because the overnight stops give an opportunity for a quiet rest, so enabling the traveller to arrive at his destination fresh.

Sir Harold Hartley expressed similar views, and in a broad-

Civil Aviation News . . . . .

cast from Sydney last November he said: "I cannot help feeling that the flying boat, with its flexibility which played such a vital part in our communications in the war, must have a future in the Empire, and especially in the islands of the Pacific."

From the foregoing it is evident that B.O.A.C. is not against the flying boat as such. Objections to this type of aircraft in the past have been due to considerations connected with the routes and with the expense of terminals. In the case of the large Saunders-Roe *Princess* class, the picture is different. Stages will be longer, and consequently there will be fewer bases to be established. Also, the large boats will be more economical to operate. When it comes to sizes such as that of the *Princess* class, the flying boat scores in that Nature provides runways of unlimited length. Moreover, the weight and complication of an undercarriage are avoided, with favourable effect on payload. We gathered from Sir Miles Thomas that if these boats come up to the estimated performance in passenger capacity and range, they will be employed to the fullest possible advantage.

A mission sent out by the Ministry of Civil Aviation returned recently from South America, where it had surveyed possible flying-boat bases on the east coast. No official report has yet been issued, but Mr. Geoffrey Tyson, Saro's chief test pilot, was very pleased with the relative ease of establishing permanent bases, and with the number of available alternatives, such as harbours and estuaries, that could be used for diversions in case of need.

B.E.A's NEW ASSOCIATES

As reported in *Flight* last week, permission to operate 29 scheduled internal services, in addition to a number of inclusive tours and short-period services, has been granted to 17 air charter companies, who will fly the services as associates of British European Airways. In their agreements with the associate companies B.E.A. undertake to receive bookings and handle passengers on their behalf at any airport where B.E.A. facilities already exist. The duration of the agreements varies from a few months to two years, and the routes to be flown by each company are as follows:

SCHEDULED SERVICES.

Air Enterprises.—Croydon/Isle of Wight, London/Birmingham, London/Manchester.

Barclays International Airways.—Croydon/Birmingham, London/Birmingham.

Cambrian Air Services.—Cardiff/Barnstaple, Cardiff/Birmingham, Cardiff/Jersey and Guernsey, London/Cardiff, Weston-super-Mare/Cardiff.

Hornton Airways.—London/Exeter/Plymouth, London/Land's End.

Lancashire Aircraft Corporation.—Blackpool/Isle of Man, Blackpool/Jersey, Blackpool/Southport, Leeds/Isle of Man, Leeds/Jersey, London/Blackpool, London/Leeds.

Northern Air Charter.—Newcastle/Belfast, Newcastle/Isle of Man.

North-West Airlines.—Birmingham/Isle of Man, Blackpool/Isle of Man, Glasgow/Isle of Man, Manchester/Isle of Man, Newcastle/Isle of Man.

Patrick Aviation.—Birmingham/Blackpool, Birmingham/Isle of Man, Birmingham/Jersey, Birmingham/London, Birmingham/Southampton.

Scottish Aviation.—Glasgow/Isle of Man.

Sivewright Airways.—Manchester/Isle of Man, Manchester/Jersey.

Somerton Airways.—Portsmouth/Isle of Wight, Southampton/Isle of Wight.

Transair, Ltd.—London/Blackpool.

Western Airways.—Weston-super-Mare/Cardiff.

INCLUSIVE TOURS.

Air Transport Charter (Channel Islands).—Newcastle-Jersey.

Flightways.—Southampton/Jersey and Guernsey.

Transworld Air Charter.—Birmingham/Belfast.

Ulster Aviation.—Aberdeen/Belfast.

AUSTRALIAN OPERATIONS IN 1948

THE Qantas Constellation service between Sydney and London carried 7,897 passengers during its first year of operation, according to figures recently announced in Sydney.

Australia's regular airlines last year carried 32 per cent more passengers and 72 per cent more cargo than in the previous year. The total number of paying passengers transported in 1948 was 1,350,000, while freight totalled 31,719 tons. During 1948, the route-miles covered by the 16 operating companies increased by 26 per cent as compared with 1947, and the number of hours flown was increased by 23 per cent.

In spite of dollar restrictions, the British Commonwealth Pacific Airways service to Vancouver carried 4,583 paying passengers, 1,000 more than in the previous year. On the Pacific service, 50 per cent of the available seat-capacity was occupied, compared with 70 per cent on the London service.

CHIMNEY-PIECE: Flue-brush work in the exhaust stacks of a K.L.M. Convair 240 at Schiphol. The "banana-skin" cowling is peeled open to give full access to the Double Wasp.

BREVITIES

AFTER a four months' operational test of a Bristol Freighter, Australian National Airways have shown their satisfaction by placing an order for three more of these aircraft, at a total cost of about £160,000 sterling.

* * *

The second of a series of Meteorological Reports, *Aviation Meteorology of the Azores*, has recently been published by the Air Ministry. It is obtainable from His Majesty's Stationery Office, price 3s 6d.

* * *

It is reported from Australia that Qantas Empire Airways will shortly take over a number of Skymasters belonging to British Commonwealth Pacific Airlines, who are now operating with DC-6s on their trans Pacific route. Qantas is due to start a new service between Sydney and Hong Kong in June.

* * *

The weekly B.O.A.C. Solent service to Dar-es-Salaam now makes a night-stop at Kisumu instead of Kampala on both flights, and the removal of the Egyptian night flying ban recently has enabled a night-stop to be made at Alexandria on the return flight; Luxor, where a night-stop is made on the outward flight, is now overflown. On both outward and inward flights a night stop is made at Augusta and a short halt at Khartoum.

* * *

The twelve Convair 240 airliners which recently went into service on K.L.M.'s European routes are named after seventeenth-century Dutch painters, and in the cabin of each aircraft hangs a painting by the aircraft's namesake. Before the war K.L.M. aircraft were named after birds, and since the war their Constellations and DC-4s have been given the names of Dutch towns, provinces and overseas territories, while DC-6s have been christened after members of the Netherlands Royal Family.

* * *

After three years' study, I.C.A.O. has announced that agreement has been reached between the 51 member states on the new rules simplifying international air travel. These rules, due to come into force on March 1st, 1950, include the reduction of entrance and exit requirements, standardization of the num-

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ber and content and forms, and adjustment of customs, immigration and related regulations. They will also have the effect of reducing passengers' ground-waiting time and airlines' clerical staffs, and may eventually have some effect on the cost of air travel.

* * *

Olley Air Services of Croydon have again arranged to carry visitors to Jersey for the International Road Race on April 28th. Aircraft will leave Croydon at 0900 hr and return by about 1930 hr. The day return fare will be £10. For those wishing to arrange their own parties, twin-engined aircraft may be chartered.

* * *

It is reported from Pretoria that the Israeli Government has reached agreement with a number of civil air lines—including the South African company Pan-African Air Charter—for the transport of 80,000 displaced persons from Munich to Haifa. The Israeli Government is understood to be contributing £5 per passenger.

* * *

Twice-weekly direct air services between Scotland and Switzerland will be started on May 14th by Swissair. The service will leave Renfrew Airport on Saturdays and Sundays at 0930 hr and reach Zurich at 1530 hr. The return flights will leave Zurich on Fridays and Saturdays.

* * *

In Schedule II of the Air Navigation Order which came into force on April 1st the minimum safe altitude is altered to 1,000ft above the highest obstacle within a radius of 2,000ft from the aircraft, instead of 1,000ft above the ground, as before. Helicopters may fly below this altitude if prior written permission is obtained from the Ministry of Civil Aviation.

IMPERIAL RECOLLECTIONS: Sir Harold Hartley, Chairman of B.O.A.C., was chairman at a luncheon party last week to former directors of Imperial Airways and a number of officials who had served for over 25 years with the old and new organizations. Sir Harold is seen here in conversation with Mr. S. Oldfield and Capt. O. P. Jones. A brief report appears on page 424.

Two more appointments recently announced by Canadian Pacific Air Lines in connection with the operation of the new trans-Pacific routes are those of Mr. H. Fletcher as general superintendent of maintenance and overhaul, and Mr. T. W. Siers as maintenance research representative. They will make their headquarters in Vancouver when the operational and maintenance departments are moved from Winnipeg.

FROM THE CLUBS

THE six Australian flying clubs have formed the Aero Club Federation of Australia to take the place of the old organization known as the Associated Aero Clubs of Australia, which functioned as the mouthpiece of the clubs before the war. The new Federation is affiliated to the Federation Aeronautique Internationale and, under the secretaryship of Mr. M. G. McSpedden, has headquarters at 195, Elizabeth Street, Sydney. The A.C.F.A. will in future control all aeronautical sporting events, racing and attempts on records by power-driven aircraft, gliders and models, appoint observers, issue certificates and generally carry out the functions of the F.A.I. in Australia. The first meeting of the Council is to be held on April 23rd and 24th.

* * *

KUALA Lumpur Flying Club held its annual general meeting on March 25th and reported a very satisfactory year. Operating with three Tiger Moths and a two-seater high-wing monoplane, the Club now has a total of 548 members, of whom 273 are active flying people. In addition to logging 1,197 hours' flying during the year, the Club carried out a considerable amount of charter work.

During the year 42 members received flying instruction, 17 obtaining their "A" licences, and requests have been received from Johore, Malacca and Segamat to give flying instruction there during the coming year. Although no subsidy has been granted by the Malayan Government, the rebate of duty on petrol has enabled the club to keep flying fees at a moderate level.

* * *

FOLLOWING the success of their air display last year, the Cowes Aero Club has planned three displays and rallies for this summer. They will take the form of novelty displays and flying competitions, and invitations have been sent to all the mainland flying clubs. Ideas for new competitions are also being sought. Pilots willing to contribute to the success of the Cowes meetings are asked to communicate with the display organizer, Mr. Richard Turlington, at Cowes Airport.

During March the flying instructors were kept unusually busy for the time of the year and eight new "A" licences were obtained. A new instructor is Mr. Leslie C. Hilditch, who was a Fleet Air Arm instructor during the war and later became flying instructor to the Royal Pakistan Air Force. Daily hire of aircraft at special rates proved particularly popular; two Austers flew from Cowes to Liverpool for the Grand National. On Sunday, March 27th, no fewer than 15 aircraft from other clubs visited Cowes, a figure which, it is felt, augurs well for the summer. New aircraft are being obtained in preparation for an active season and holiday-makers are again invited to take advantage of the "learn-to-fly holiday" plan.

* * *

WITH the improvement in the weather during the last two weeks of March, flying time at the Strathtay Aero Club totalled 65 hours for the month. There was the expected spurt by those under instruction to obtain their "A" licences before the new regulations came into force on April 1st and three people qualified, including Mr. J. Johnson who, at the age of 17, is the Club's youngest member. There are now 59 holders of current licences and eight members are still under instruction.

On a doctor's recommendation, two high flights were made with children suffering from whooping-cough; in one case a complete cure was effected but in the other there was only a temporary improvement.

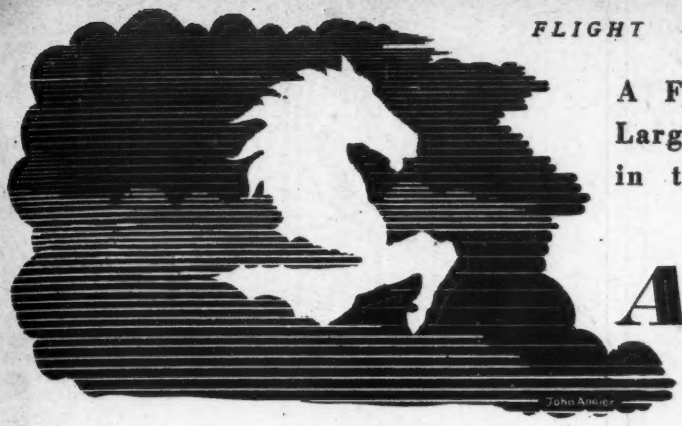
After very lengthy discussions the Scottish Flying Club has at last obtained permission for qualified pilots to fly from Renfrew Airport under certain conditions, but instruction will still be carried out at Perth.

* * *

THE South Coast Flying Club, at Shoreham Airport, started their summer season with a most successful dance on Saturday, April 9th. If sufficient support is promised, Mr. Tilghman Richards will, on April 23rd, give a ciné and lantern lecture on the famous "Flying Doughnut" which was built at Shoreham in 1910. The film also contains shots of the airport in its early days.

The Club has recently obtained a licence to serve light lunches, snacks and hot beverages on the premises. Prices are reasonable and it is hoped that sufficient support will be forthcoming to enable the innovation to continue throughout the summer.

A number of coach trips have been arranged for the summer and the first, on Saturday, May 21st, is to attend the 21st anniversary of the Northampton Aero Club, where an air display is being held; the second is for the Derby on June 4th, when the party will leave Shoreham at 11 a.m.; on July 23rd a party is being arranged to attend the Gatwick Air Display; and the date of a trip to view the Brabazon at Bristol will be announced later.



A Further Examination of the Largest and Heaviest Helicopter in the World : Control Features

Air Horse

Part Two

IN the preceding section of this analysis ("Flight," April 7th) the general features of the Cierva Air Horse were reviewed and brief reference was made to the control system employed in this very interesting aircraft. In the present article the picture is completed by a survey of the mechanical elements of control, the process of pitch-change application to the rotor blades, and the distribution of thrust as between the three rotors resulting in the variety of flight manœuvres.

BEFORE proceeding to an examination of the media between cockpit controls and the rotors themselves, it is desirable that a general statement be given on the fundamentals of control involved. Regarding a helicopter rotor simply as an airscrew rotating in a substantially horizontal plane, the ability of the aircraft to hover, ascend and descend vertically is readily understandable. If the lift exceeds the all-up weight, the aircraft ascends; if the lift exactly balances the weight, the aircraft hovers; and if the lift is not as great as the weight, the aircraft descends. The lift (or thrust) developed in the rotor is a function of rotational speed and the angle of attack of the blades, the power input being, in turn, determined by the power required to keep the rotor turning at a given speed with its blades at a given angle of attack.

Broadly, it is desirable that the rotor should rotate at its optimum r.p.m., the lift being adjusted by variation of the blade pitch and the resultant power demand met by variation of engine supercharge. Unfortunately, when a mass is rotated on a shaft, an equal and opposite turning reaction is produced, and in a helicopter the effect is to tend to spin the body of the machine around beneath the rotor. It is for this reason that, in single-rotor aircraft, compensation for torque reaction is provided in the form of a lateral rotor at the tail, or, as in the Fairey Gyrodyne, an offset airscrew. With rotors driven by jet reaction at the blade tips, torque reaction is non-existent, and therefore does not have to be compensated. Equally, by employing two rotors turning in opposite directions, the reaction of one can be made to compensate that of the other, but this configuration can bring with it undesirable problems of pendulum instability.

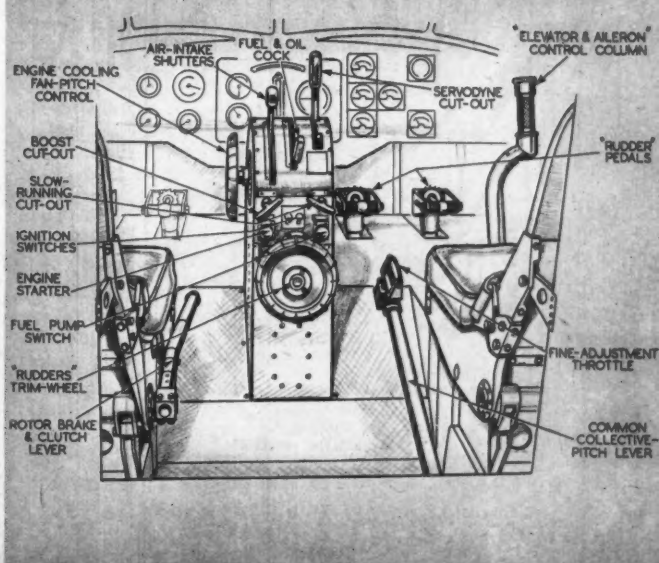
As explained in the first instalment of this review, the original Weir helicopters conceived by Mr. Pullin were both twin side-by-side rotor aircraft, and, as a result of the flying experience with these machines, the soundness of the control characteristics was proven, and the necessity for a third rotor indicated. In addition, as also mentioned previously, there is a (present) limit of practicability on rotor diameter, and this means that, in order to lift greater loads, more rotors are required. These were the contributory causes in producing the Air Horse in its present form to fulfil the performance requirements.

As regards torque reaction, the three Air Horse rotors all turn anti-clockwise as seen from above, and thus tend to rotate the aircraft as a whole in the opposite direction. However, by attaching the rotors to the outrigger booms in such a manner as to provide an inclination of the natural thrust axis, compensation for torque reaction is provided. Naturally, this compensation will afford an accurate balance only at one operating condition (in this case, cruising), but the degree of unbalance for all other flight conditions is quite small, and is sufficiently met by the provision of adjustable vertical surfaces at the tail of the fuselage so that the unbalance can be trimmed out.

Having examined the basic lift action of a rotor, we can

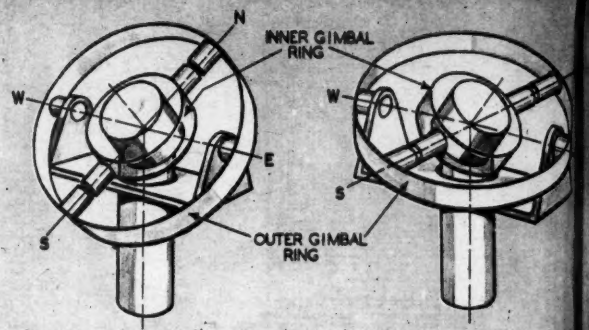
Detail of rotor head showing swashplate, drop arms, flapping and drag articulation linkage and hydraulic snubber units.

The two-seat cockpit is fitted with fully duplicated primary controls, whilst the secondary controls are all carried on a central pedestal.



now go on to appraise the reasons for, and actions of, blade pitch-change. The angle of attack of a blade—or its pitch—if remaining unchanged during any one blade's sweep round the full circle, will result in a constant lift. And by altering the pitch of all three blades simultaneously and by a like amount, the lift of the rotor as a whole is appropriately altered. This is referred to in rotary flight terminology as "collective" pitch-change. There is, however, another form of pitch alteration, and this is called "cyclic" pitch-change.

Cyclic pitch is a self-explanatory term in that it implies the harmonic variation in pitch angle which a blade can make whilst rotating around the hub. For the sake of example, this can be illustrated as a blade pitch angle of, say, 5 deg when the blade is pointing north; 10 deg when



Above is a schematic illustration showing how the elbow crank of the cont... gimbal-pivoting to tilt the head. At centre is a detail through the swash... tilted position, whilst at right is a schematic plan section of the head i... showing how the swashplate spider rotates around the stati...

AIR HORSE . . . . .

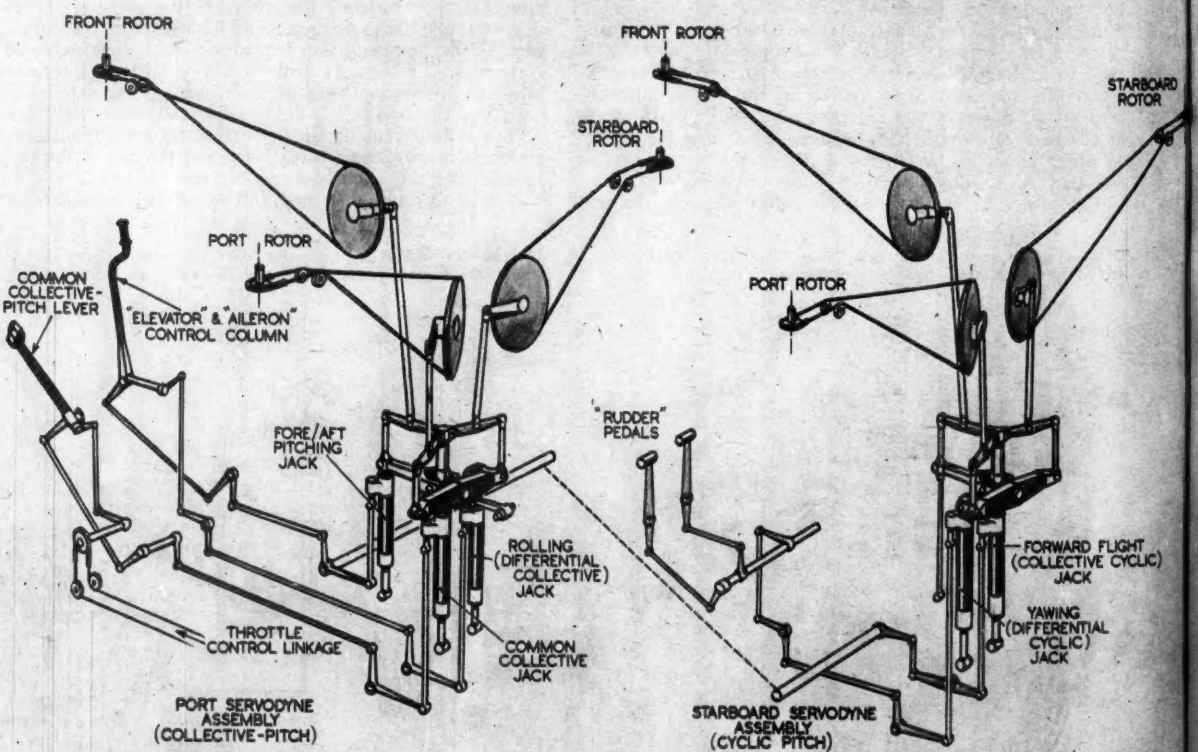
the blade is pointing west; 15 deg when pointing south; 10 deg when pointing east, and back to 5 deg at north. This supposes a rotor motion anti-clockwise in plan, as in the Air Horse.

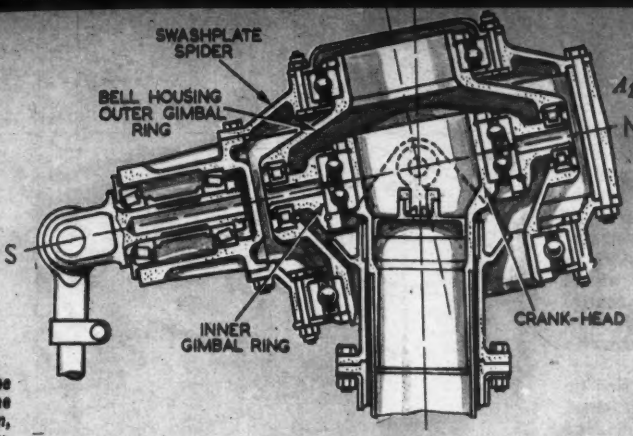
At this stage it might, perhaps, be as well to review briefly the method of blade articulation as given in detail in the previous issue. Each blade is carried off the hub by means of links pivoted horizontally at the inboard, and vertically at the outboard ends, in order to permit the blades both to flap up and down and also to vary their position in azimuth, i.e., to alter their angular dispositions relative one to each other. On the axis of the flapping link, and housed within the link, is a torque shaft incorporating a universal joint coincident with the drag-hinge axis, the outboard portion of the torque shaft being formed as a semi-torous to engage with the twin-row, taper-roller bearing mounted on the drag hinge link. By this means, rotation of the torque shaft will effect blade pitch-change, any angularity due to movement of the blade about the drag hinge being accommodated by the universal joint in the torque shaft. The twin-row, taper-roller bearing allows the blade pitch to be altered with quite low control forces despite the high centrifugal loading.

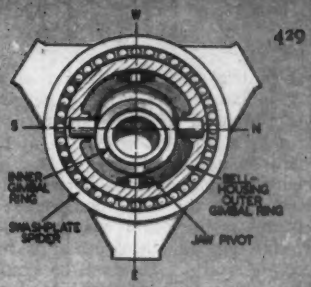
Dual control is provided in the Air Horse for two pilots side-by-side, the primary flight controls being vested in a control column for "elevator" and "aileron" action, a pair of pedals for "rudder" action, and a sloping, pull-up/push-down lever for ascent and descent action. There is no separate throttle control in the accepted sense: each common-collective pitch lever is mechanically linked to the engine throttle so that pull-up action of the lever to increase collective pitch and so obtain vertical lift also results in the simultaneous opening of the throttle. Conversely, pushing the lever down to reduce collective pitch simultaneously closes the throttle. A refinement is added in the form of a spade-grip handle on the lever which can be turned to give a measure of over-ride in throttle control, in order to allow the engine power output to be matched accurately with the rotor power requirements.

From the pilots' controls in the cockpit, a system of push-pull rods transmits control motions to the base of the

In the diagram shown below, the port and starboard halves of the control assembly have been separated for clarity. Understanding of the action of the Servodyne assembly in translating pilot's control motions to pitch-change motion at the rotors is amplified by the detail drawing at right.



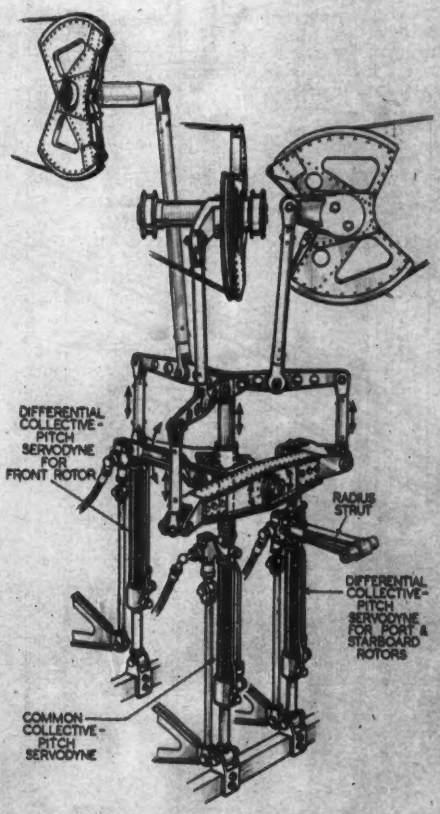




...of the control is used via the ... the swash... assembly in the ... the head in ... fore and aft position, ... the static... gimbal assembly.

Lockheed Servodyne assembly in the forward part of the engine room. The push-pull rods terminate in bell-crank connections to vertical rods pin-jointed at their upper ends to the individual control valves of the Servodyne jacks. Thus, the pilots' control motions are actually used to move the appropriate valves and so determine the direction of jack movement, the power source for actuating pitch-change of the rotor blades being provided by the hydraulic system serving the jacks.

The Servodyne assembly in the engine room is divided into port and starboard halves, the former catering for collective pitch, whilst the latter accommodates cyclic pitch. The jacks are all anchored to the belly structure of the fuselage by means of their piston rods, the heads of the jack cylinders being pin-jointed to an articulated yoke linkage from which vertical connecting rods run up to the tips of three spoke-arms commonly anchored at their inner ends to the head of a vertical shaft. Approximately 40 per cent along each of the spoke arms is pin-jointed the foot of a vertical link pivoted at the head to a crank arm from the pulley around which is wrapped the cable transmission linkage running out along the outrigger boom to the rotor hub. As the whole assembly is duplicated, it follows that there are two separate cable control runs in each of the three rotor booms, one for collective pitch and one for cyclic pitch control. The actual transmission is made up with 20-cwt Tru-lay cable around the pulleys and fairleads where change of direction occurs, the intermediate spans being made up with ¼in diameter bright steel tie-rod, whilst ¼in pitch, 2,000 lb Renold chain inserts are incorporated for matching with the sprockets at the heels of the control shafts in the rotor hubs. The mechanical geometry of the Servodyne assembly is such that it is more readily understandable from a drawing than from a textual description.


DIFFERENTIAL COLLECTIVE-PITCH SERVODYNE FOR FRONT ROTOR
RADIUS STRUT
DIFFERENTIAL COLLECTIVE-PITCH SERVODYNE FOR PORT & STARBOARD ROTORS
COMMON COLLECTIVE-PITCH SERVODYNE

The Servodynes are supplied with oil at 2,500 lb/sq in cut-out pressure from the Lockheed Mk. VI pumps driven from the engine and the distribution gearbox. Each pump is capable of serving both the hydraulic accumulators. Each of the latter feeds into a common junction box from which the jacks are supplied; thus the system is duplicated up to the junction box. The complete hydraulic system (aside from the pipe runs) is nested as a common installation in a box mounted on the starboard wall of the fuselage in the forward section of the engine room.

With the powered control system in its present form, there is no feed-back to give "feel" in the pilots' controls, but a scheme is in hand for incorporating artificial "feel", by means of spring pre-load embodying adjustment of the null point. This refinement should permit the pilot to trim out the control stick forces to any required datum setting.

Thrust Distribution

It is advisable at this point to consider the distribution of thrust function between the rotors. Regarding the three rotors respectively as A (front); B (port); and C (starboard); the individual rotor action for producing the four freedoms of motion is as follows: to produce roll, A remains neutral whilst a differential collective pitch is given to B. and C.; for fore and aft pitching, differential collective pitch-change is given between A, and B+C; for yawing motion A remains neutral whilst differential cyclic pitch is given between B and C; vertical motion is, of course, produced by collective pitch given commonly to A, B and C simultaneously.

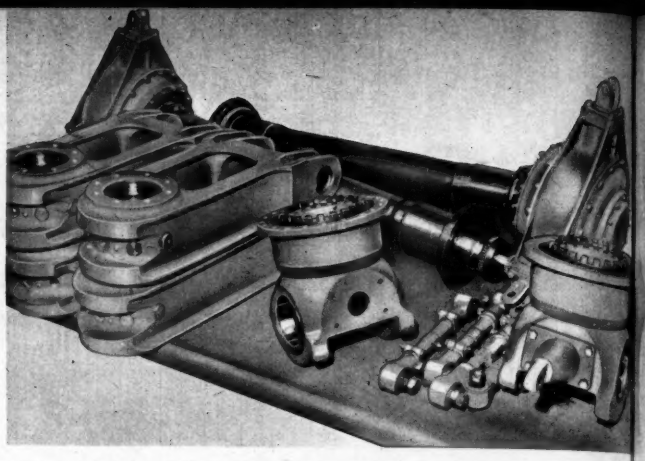
These can be considered as the fundamental control functions which will give attitude change about the aircraft's centre of gravity. Naturally, however, the inclination of the individual thrust vectors incurred in these manœuvres (with the exception of the last-mentioned) will secondarily result in a measure of directional progress. Reference to the detail drawings and diagrams of the control transmission system should make readily understandable the selection and sequence operation of control paths between cockpit and rotors to bring about any of the mentioned flight manœuvres.

Here, perhaps, it will be helpful to consider the manner in which control selection is translated at the rotor hub into an appropriate blade pitch movement.

Running up through the centre of each hub are two

concentric shafts, the outer of which imposes collective pitch-change, whilst the inner governs cyclic pitch-change. At the head of these shafts is the swashplate assembly which, it should be clearly understood, is only a swash-plate in a limited sense. That is to say, it is capable of being tilted about one horizontal axis only, e.g., east and west, and the only component of the assembly which rotates is the outer casing, or spider, from the arms of which depend the drop arms to the blade pitch-change torque shafts. It must be emphasized that the interior mechanism of the swashplate assembly *does not* rotate with the hub.

The spider outer casing of the swashplate is carried on ball bearings at the crown and skirt of a bell housing which is, in effect, the outer ring of a gimbal. This bell housing is pivoted in jaws formed at the head of the collective



Various dissembled rotor-head detail components on the bench.

Below: vertical section showing control shafts and swashplate head.

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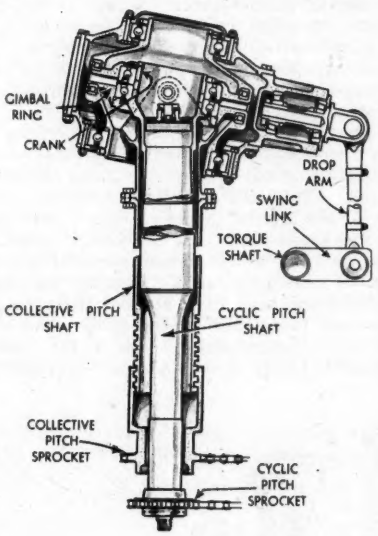
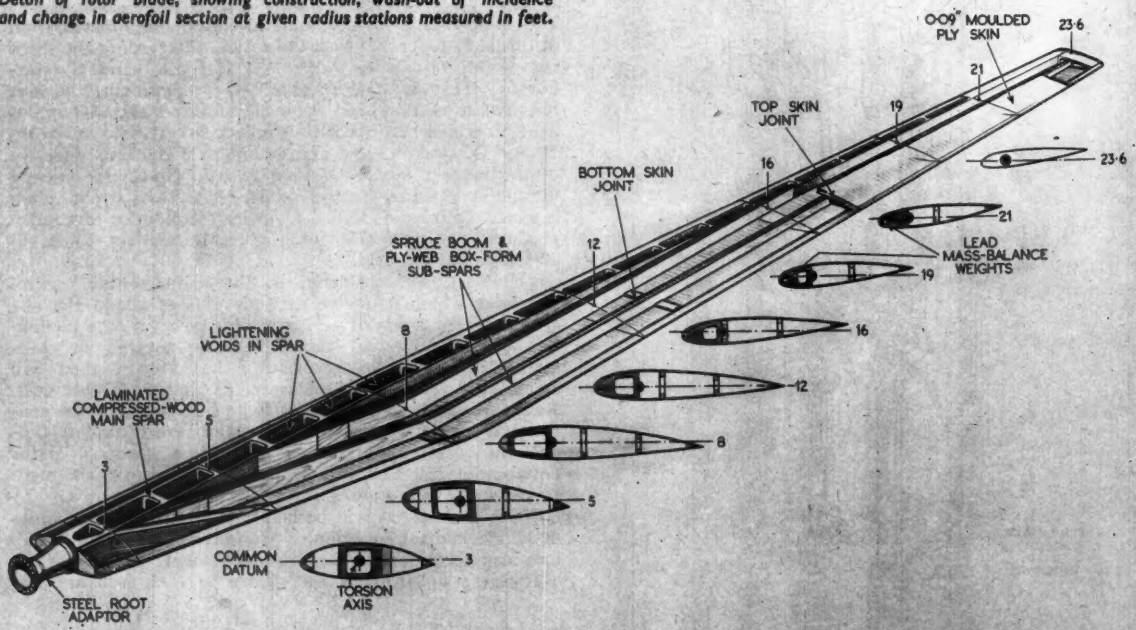
pitch control shaft, vertical movement of which results in the whole swash-plate assembly being lifted or lowered, as the case may be, to impose simultaneous and coincident pitch-change of all blades. Pivoted across the diameter of the bell housing, or outer ring of the gimbal, and at 90 deg to the pivot axis through the jaws, is the inner gimbal ring. This accommodates, in its bore, the twin-row ball bearing assembly in which registers the cranked end of the inner of the vertical control shafts, i.e., that governing cyclic pitch.

Although at first sight somewhat involved, the essential tilting of the swashplate assembly and the means of achieving it are relatively simple. With the aid of the accompanying diagrams, we can illustrate it as follows: visualizing the inner gimbal ring pivoted on a north/south axis, and the outer gimbal ring (bell housing) pivoted in the jaws on an east/west axis, when the cranked head of the cyclic pitch shaft is, for example, inclined to the east, the inner gimbal ring will also be similarly inclined by tilting about its north/south axis. This will have no concurrent effect on the outer ring bell housing, which will remain horizontal. When, however, the shaft crank head is turned 90 deg to bring its inclination either to the north-ward or southward, it necessarily inclines the inner gimbal ring in the same direction, and, as this is pivoted at north and south in the bell housing, the latter must necessarily take on a coincident inclination. As the spider casing is rotating on the bell housing, it therefore follows that any inclination of the latter must also incline the spider casing to the north or south, as the case may be, and thus lead to cyclic variation in blade pitch angle during rotation.

The coaxial shafts for collective and cyclic pitch-change are actuated by



Detail of rotor blade, showing construction, wash-out of incidence and change in aerofoil section at given radius stations measured in feet.



Air Horse . . . . .

means of sprockets with which engage the chain inserts in the control transmission. For the inner shaft governing cyclic pitch, the sprocket can be mounted direct on the heel of the shaft, since the total turning motion involved is but 180 deg, i.e., 90 deg from east to north, and 90 deg from east to south. For the collective-pitch shaft, however, the matter is somewhat more difficult, in that rotary motion at the sprocket must be converted into vertical motion in the shaft: the obvious method is to employ a screw jack. The sprocket is splined to a nut sleeve engaging threads cut in the skirt of the shaft. Above the nut is a keyed sleeve, the keys of which engage ways cut through the screw jack threads in order to prevent rotation of the shaft and ensure vertical movement only. The keyed sleeve is bolted to the base plate of the hub gearbox, and in its mouth houses the ball race in which the nut sleeve is located and rotates. In turn, in the mouth of the nut sleeve is a needle roller bearing in which the cyclic-pitch shaft rotates. At the head, the cyclic-pitch shaft is steadied in a plain Tufnol bearing in the mouth of the collective pitch shaft, between the jaws.

With the survey of the mechanical design of the control system, and the fundamental control actions behind us, we can now revert to a consideration of blade articulation and movement. To take the flapping hinges first: these are embodied to allow the blade to take up a compromise position between the directions of centrifugal and lift forces. When any collective pitch-change is being imposed, the tip-path plane will be normal to the hub axis. When, however, cyclic pitch is imposed, the blade tends to flap upward under the influence of an increased angle of attack, and subsequently to flap downward as the angle of attack is reduced. Thus, although the lift of the rotor as a whole remains substantially the same, the flapping action of the blades as they rotate has the same effect as tilting the whole rotor, and, by virtue of this action, the thrust axis is tilted and so provides a couple about the aircraft's centre of gravity, which leads to directional motion imposed on the aircraft as a whole.

Azimuthal Variation

The drag hinges accommodate variation in the angular disposition of the blades one to each other. When the aircraft is in directional flight, there is a relative air speed across the rotor as well as the flow through the rotor. For purposes of illustration, we can visualize the aircraft as flying northward and, thus, there will be a relative airflow across the rotors from north to south. If, as in the case of the Air Horse, the blades rotate anti-clockwise when seen from above, in moving from south through east to north a blade will encounter greater relative airflow than it will in rotating from north through west to south. For this reason, the former is said to be an "advancing" blade, whilst the latter is referred to as a "retreating" blade. Obviously, the drive imparted by the engine must be regarded as of constant angular velocity and, therefore, the rotor hub must similarly be regarded. Even without the complication of cyclic pitch-change, however, it is readily apparent that the drag of an advancing blade is greater than that of a retreating blade, and thus the advancing blade tends to lag and the retreating blade to accelerate relative to their nominal angular dispositions. The drag hinges in the blade articulation linkage are embodied to accommodate this tendency, but the oleo-pneumatic snubber units are fitted to provide some restraint to these azimuthal variations and damp out what might otherwise be dangerous cumulative accelerations. C. B. B.-W.

HONOUR FOR D.H. ENGINEER

MR. W. T. WINTER, A.M.I.A.E., chief development engineer on the Ghost engine, has been awarded the President's Gold Medal of the Society of Engineers for his paper *The Development of the Jet Propulsion Engine*, which he read before the Society on May 3rd last year. This is the premier award for all papers read during the 1948 session and, in the President's own words, its winning represents a most noteworthy achievement.

PROTECTIVE PLASTIC COATING

OF particular value for the protection of highly finished light-alloy and other metal sheet during assembly, and for the protection of parts in transit, an improved form of Avigel protective coating has been evolved. The earlier substance of this name required a hot-dipping process of application, which naturally limited its usefulness, but the new material, known as Avigel "100," can be applied cold by brushing or spraying.

The transparent coating formed is thin but tough, with a rubbery consistency, and can be peeled off without difficulty when no longer required. Six colours are available. It is stated to be proof against water oxidation, mineral acids and alkalis in any strength, and most greases, oils and solvents, and to be unaffected by extremes of ambient temperature or by fungi, bacteria and moulds. Sold in one- and five-gallon tins, and capable of covering 250 sq in for one penny, it is claimed to be the cheapest form of such protection at present available.

Avigel "100" is obtainable from Clear Glass Products, Ltd., 16-18, Malvern Road, Southampton.

A.R.B. NOTICES

THE Air Registration Board has made a third issue of No. 3 in the series *Notices to Licensed Aircraft Engineers and to Owners of Civil Aircraft*. It points out that the Air Navigation Regulations (which came into force on April 1st) require that the certification of an aircraft before flight shall be made in respect of the airframe by an aircraft engineer licensed in Category "A" and in respect of the engines by one licensed in Category "C." The respective duties of engineers licensed in the two categories are given in an appendix.

A second issue has been made of *Notice* No. 8; it concerns the Air Navigation (Radio) Regulations, 1949, which require all matters relating to the maintenance of radio apparatus installed in aircraft to be certified by radio-maintenance engineers licensed by the Ministry of Civil Aviation. The introduction of these radio engineers' licences does not affect the present duties of licensed aircraft maintenance engineers. Enquiries regarding the new licences should be addressed to the Secretary, the Ministry of Civil Aviation.

SWIFTLY SUNWARDS

LAST Friday Mr. John Derry, the de Havilland experimental test pilot, won the Coupe Montana, a prize offered for the first flight from Paris to Cannes in under one hour. In a standard Vampire Mk. 5, powered by a de Havilland Goblin 2 turbojet, Mr Derry had flown from Hatfield to the airport at Le Bourget on the previous day. Taking off from Le Bourget, he flew the 440 miles to Cannes in 44 min 51 sec, at an average speed of 589 m.p.h. After crossing the finishing line, the Vampire landed at Nice airport.

KING'S CUP AND NATIONAL AIR RACES

THE Royal Aero Club announces that His Majesty the King has graciously approved the revival of the King's Cup Race; the event will take place on July 30th, as part of a large-scale air race meeting, to be known as the National Air Races and to be held over the August Bank Holiday week-end. The Ministry of Civil Aviation has granted permission for the event to be held at Birmingham Airport.

There will be eleven races, each race a short closed-circuit course. Prize money of at least £1,500 has been guaranteed. The provisional programme is as follows:—

Friday, July 29th.—Arrival of competing aircraft.

Saturday, July 30th.—(1) Heats and final of a handicap race for aircraft constructed within the British Empire and restricted to certain speed limits. (2) An international high-speed handicap for aircraft with a minimum handicap speed of 300 m.p.h. (3) The King's Cup Race.

Sunday, July 31st.—Aircraft demonstrations.

Monday, August 1st.—(1) International race for ultra-light aircraft. (2) Inter flying-club race. (3) International handicap restricted to aircraft fitted with reciprocating engines and having a minimum handicap speed of 300 m.p.h. (4) International handicap limited to aircraft with a certified all-up weight between 1001 and 1750 kg (2,206-3,858 lb.). (5) International handicap for jet aircraft. (6) International handicap race for aircraft with a certified all-up weight of between 501 and 1000 kg (1,104-2,205 lb).

The Royal Aero Club hopes to announce the arrangements for spectators, and full details of the programme, and to have entry forms for competitors available, by about May 18th.

ROYAL OCCASION

H.R.H. Princess Elizabeth Installed as Grand Master of the Guild of Air Pilots and Navigators

THURSDAY, April 7th, 1949, is a date which will be memorable in the history of the Guild of Air Pilots and Air Navigators of the British Empire. On that day Her Royal Highness Princess Elizabeth was installed as Grand Master of the Guild. The ceremony was held at Londonderry House, and it included the installation of the Master, Wardens and Assistants of the Court of the Guild. The ceremony concluded with these words by the Grand Master: "Members of this Guild, let justice and prudence be the guide of all your actions, and let your obedience be proved by strict observance of our Constitution, by your regular attendance at our meetings, and by your acceptance of the wishes of a majority of members." A prayer for the King and for peace throughout the Commonwealth was then offered up by the Chaplain of the Guild, the Rt. Rev. J. A. Jagoe, until recently Chaplain in Chief of the R.A.F. and now Bishop of Bermuda.

After the ceremony a reception was held at which members of the Guild were presented to Her Royal Highness, whose knowledge of aviation matters is remarkably wide. It must be supposed that the Grand Master enjoyed herself, for she remained at the reception a good deal longer than had been expected, and there can be no doubt that those assembled very greatly appreciated her gracious presence.

There was a very long toast list at the dinner which followed the reception, and at which many prominent aviation people were present. GROUP CAPTAIN W. N. CUMMING pointed out that the choice of the expression "British Aviation" for the toast which he proposed was not accidental. They could have used Civil or Commonwealth, or just Aviation, but whatever the future might hold, we had a right to be proud of our past, in aviation as in so many other spheres of National and Empire endeavour. No change of time or circumstance could alter that pride. Behind every success lay the fortitude, determination, skill and devotion of the men and women who made our aircraft fit to fly, and who kept them in the air.

Life and Happiness

A lot of nonsense was talked about importance of the Cause at the expense of the Individual. That way lay the police state. To work well we must live well, and to live well we must be happy. No scale of pay and no amount of luxury could in themselves achieve the result. It was interest in the work required which alone could make an entity of a mob, and no mob had ever been known to operate a satisfactory and a satisfying enterprise. While adequate physical reward was a pre-requisite to success, over pre-occupation with personal rights and grievances, and a rigid insistence on hours of work or of specified fields of labour were a sure sign of the lack of that vital flame which illuminated the early days of aviation. Above personal considerations must rise that belief in their cause and destiny which turned a job into an art. In the case of officers there must be confidence based on a certainty of superior knowledge. Even to-day discipline would be accepted if applied with understanding. Without discipline no organization could survive.

It was a strange thing, G/C. Cumming said, that those who had grown up with aircraft should be considered incapable of any other useful sphere of activity, while anyone from the vast outside world appeared to be worth at least one step up on joining the once exclusive band. "Be that as it may," he concluded, "those of us who are wholly engulfed in the young but nevertheless strong traditions of our calling still believe in the future, hard though that belief is tried at times. Above all, we believe in our own future."

LORD PAKENHAM, Minister of Civil Aviation, paid a warm tribute to the memories of A Cdre. Brackley and Lord Londonderry. Among those present many had helped to save the country, and in the civil field also British crews were the best in the world. In aviation there was greater enthusiasm than anywhere else in our national life. As for our aircraft position, that was improving and the new machines would prove a credit to all concerned. He was much concerned with the future of our civil pilots. After achieving so much they must not be thrown on the scrap heap. Ministers of Civil Aviation were liable to have an even shorter life than pilots, but if he was still at M.C.A. next year he hoped to report progress in the matter of looking after pilots who had become too old to fly.

The toast of The Guests was proposed by THE RT. REV. J. A. JAGOE, who expressed his regrets that on becoming Bishop of Bermuda he had to resign as Chaplain of the Guild.

AIR MARSHAL SIR ALEC CORYTON replied for the guests. Those present had built up a great reputation as pilots and navigators, upon which greater safety depended. He did not believe that "boxes" would replace aircrew or relieve them of responsibility. "Boxes" were never wholly reliable, and too much reliance should not be placed on them.

Merit Recognized

Two awards were presented at the dinner. The Johnston Memorial Trophy had been awarded to Captains W. H. Crowther, R. B. Tapp, and L. R. Ambrose, of Qantas Empire Airways. In their absence the trophy was accepted on their behalf by Capt. Ritchie, another distinguished member of the company. In making the presentation G/C. Cumming recalled that he saw the inception of the service between Koggala in Ceylon and Perth in Western Australia. That was during the war, when the service was run in conjunction with the R.A.F. Through the war and since, this route had been operated with outstanding success over a distance of more than 3,000 miles, with only the tiny Keeling Cocos Islands some hundreds of miles off the direct track. The trophy, he recalled, was awarded in memory of S/L. Johnston, the first Deputy Master of the Guild and the first air navigator in the real sense. They were doing just honour to his memory by making this year's award to three of the original members of the Ceylon-Australia team.

In the absence of Miss Cumberbatch through illness, G/C. Cumming said it fell to him to present the Cumberbatch Trophy (for reliability) to the widow of one of his oldest friends, A. Cdre. H. G. Brackley. There was a complete rightness in this award, as A. Cdre. Brackley strove for that very thing —reliability—which, in his interpretation, meant safety for those who came after. Brackley himself was a pioneer, taking risks when they had to be taken in order that others might be safe. Through the faith and generosity of Brackley's family, a new trophy was coming into being, the Brackley Trophy for the operation of flying boats. No more fitting memorial could be devised for one of the most far-sighted, steadfast and at the same time most human pioneers of civil flying. In presenting the Cumberbatch Trophy to Mrs. Brackley, so richly earned for the second time, G/C. Cumming expressed the hope that it might comfort her to have demonstrated once more the high regard and affection in which "Brackles" was universally held.

MRS. BRACKLEY expressed her gratification that, for the second time, she and her family held in their possession the coveted Cumberbatch Trophy. This time it was as a tribute to her husband's memory and life's work. The previous time it had been awarded for his work with his companions in the early days when that great adventure, Imperial Airways, blazed the Empire Air routes. Mrs. Brackley then asked leave to say a few words on safety, its requirements and the demands on the pilot's profession as her husband saw it.

The pilot who looked for safety as a necessary attribute knew it meant hard work and a relentless eye for detail. He required the highest standard of professional honour and acceptance of personal responsibility. How far to base his decisions on meteorological reports and on his own judgment.

"My husband's fear," Mrs. Brackley continued, "was that captains might be led to put too much blind reliance on technical instruments which, however good, could never be foolproof, and to trust to the planning and method of others, instead of to their own acquired experience." The real safeguard must be the high professional standard of airline captains, individual responsibility which alone could face the unknown emergency, which called for practical knowledge, intuition, experience, quickness of decision, and leadership; and with a detailed application to meteorology, maps, maintenance, navigation, knowledge of the international code, signals and law.

"Flight" photographs.

AT THE RECEPTION: (1) Capt. G. P. Olley, John Booth and John Lankester Parker. (2) G/C "George" Bulman and Capt. James Cordes. (3) Mrs. Brackley with the Rt. Rev. J. A. Jagoe. (4) R. A. Loader, R. M. Seymour (Australian Civil Aviation Liaison Officer), T. Hewitson (South African Civil Aviation Liaision Officer) and W/C Clement Pike. (5) Charles Turner Hughes and F. Murphy. (6) Lord Pakenham, G. J. R. L. D'Erlanger and G/C W. N. Cumming (Master of the Guild). (7) F. W. Farey-Jones, F. C. R. Jacques, G. S. Lindgren and J. R. Bryans. (8) Rex Stocken with Lord Douglas. (9) Three rotating-wing experts, B. Arkell, F. H. Dixon and H. A. Marsh.

All these in turn required a high ideal of self-disciplined life. Real courage, which was true humility, and which never showed-off for effect, best knew how to face real danger and to make quick decisions when grave need arose.

These ideas, Mrs. Brackley said, were so often repeated by her husband that she felt she ought to express them, however inadequately. Had he been alive he would have been deeply grateful and have appreciated the award of this trophy for safety, an objective which he so highly prized and which could only be achieved by devoted and ungrudging hard work and self-sacrifice on the part of those who would follow Brackley.

Royal Recognition

In proposing the toast of The Guild, DR. ROXBEE COX recalled that the Royal Aeronautical Society, from the presidency of which he is shortly retiring, and the Guild of Air Pilots have a good deal in common. Each, he said, had recently been honoured by Royal recognition, the R.Ae.S. by being granted the Royal Charter, and the Guild by having Princess Elizabeth as its Grand Master. The two bodies were largely complementary: The R.Ae.S. was chiefly concerned with the technical aspects of aviation, and the Guild with the operational. Both were the oldest of their kind; the R.Ae.S. was 83, and although the Guild had not yet attained majority, it had, in choosing its title, managed to give an air of seniority.

He recalled that the "fathers" of the Guild were Sir Sefton Brancker (who could "shoot his cuffs with greater elegance than any man I knew"), and S/L. Johnston, who was a great navigator. Dr. Roxbee Cox had experienced an example of Johnston's skill as a navigator. It was in the old airship R.33 and they were in thick fog. On being asked where they were Johnston had replied that they were just over the mooring mast at Pulham. A few seconds later the fog lifted a little, and sure enough, there was the mast. He doubted, however, whether Johnston's knowledge of their position was quite as accurate as he had made out, but he certainly set a very high standard in air navigation.

MR. FRANCIS CHICHESTER but thinly disguised some home truths under a bantering tone. The Guild dealt with every aspect and problem which affected piloting and navigation, and it was ever ready to give advice to the Ministry of Civil Aviation if asked to do so. However, often it was not asked, otherwise things might be different. With a paid staff of only five, the Guild did a considerable proportion of the work done by the Ministry.

"Ask any pilot," Mr. Chichester said, "what he thinks of the running of British civil aviation. But I had better not repeat what he would say. You all know the answer." The flying clubs had been extinguished and thus a valuable source of pilots and, particularly, instructors, was being lost. Private flying was finished. In the past the private flier had contributed much to the knowledge of navigation. As for the few private companies which survived, they lived by taking in the washing of the state airlines. But the Guild would go on because its members were optimistic and believed in the future.

Lord Pakenham, Mr. Chichester concluded, had become Minister of Civil Aviation at an opportune time. He could revive civil aviation. If he had come along a year or so later, an iron lung would have been needed.

OFFICERS OF THE GUILD

HER Royal Highness installed Group Captain W. N. Cumming, O.B.E., D.F.C., as Master of the Guild in succession to the late Lord Londonderry. Officers of the Guild are:

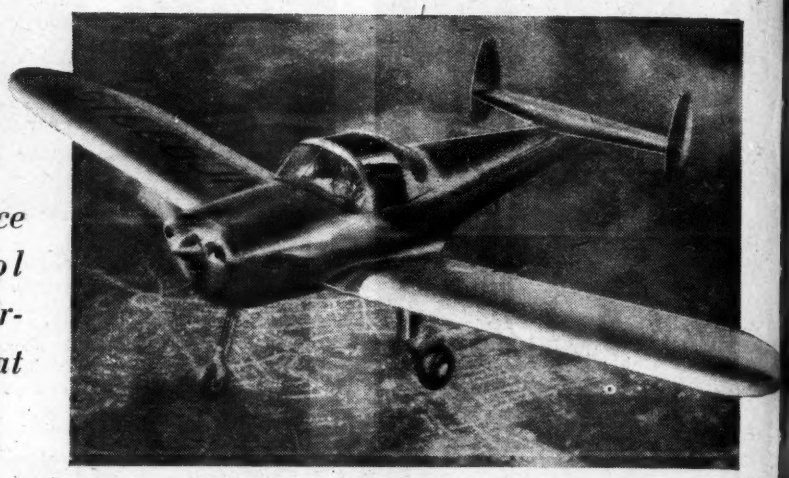
Wardens.—W/C. N. H. Woodhead, D.S.C., A.F.C.; G/C. P. W. S. Bulman, C.B.E., M.C., A.F.C.; Mr. Francis Chichester; W/C. H. F. Jenkins, O.B.E., A.F.C.; Capt. A. G. Lamplugh, C.B.E.

Court Members.—Mr. Robert Ashton; Capt. David Brice; Lt. Cdr. L. Castlemaine; G/C. D. F. McIntyre, A.F.C.; W/C. H. A. Roxburgh, A.F.C.; Capt. Gordon Store, O.B.E.; Mr. W. H. Sutcliffe; S/L. C. H. Willis, A.F.C.; W/C. W. B. Wilson; Mr. F. H. Dixon; Mr. G. A. V. Tyson; Miss Ruth M. Russell, B.Sc.; S/L. D. H. MacBeath; W/C. K. A. B. Gilfillan, M.B.E.; F/L. F. R. Leatherdale, D.F.C.

In attendance at the Installation ceremony.—L. A. Wingfield, M.C., D.F.C. (Clerk), Major J. L. B. H. Cordes (Employment Advice Bureau, test-pilot section); I. L. S. McNicol (Secretary-General); Right Rev. J. A. Jagoe, C.B., C.B.E., D.D., M.A., K.H.C. (Bishop of Bermuda and Guild Chaplain).

ERCOUPE IN THE AIR

Renewing Acquaintance with a Two-control "Foolproof" Light Aircraft : Investigations at Farnborough



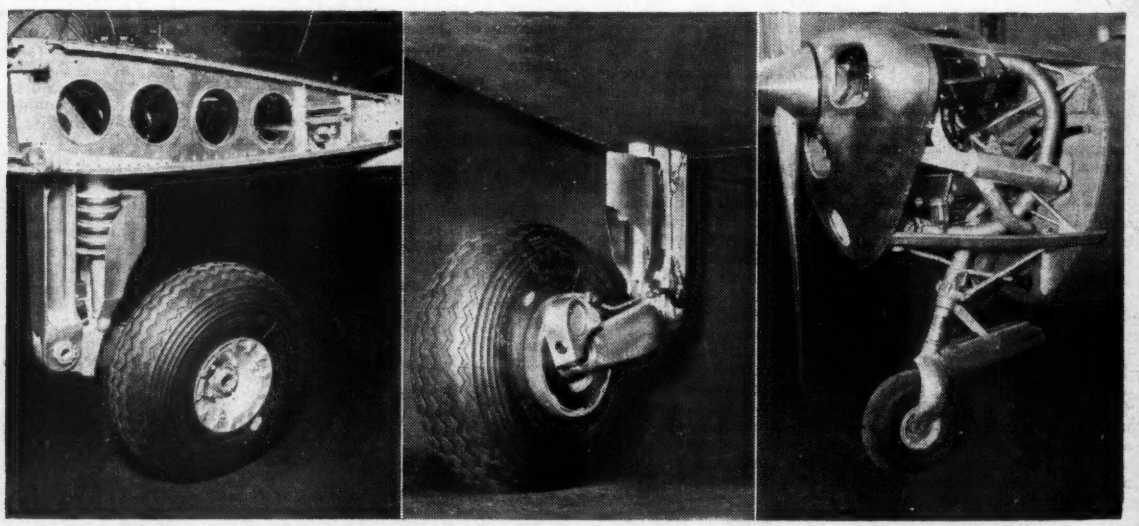
IT is perhaps surprising to find among the wide variety of aircraft at present operated by the Aerodynamics Flight at Farnborough — Vampires, D.H.108, Mosquito, various helicopters, and machines for low-speed investigation such as Fieseler Storchs and the Youngman-Baynes—a not-very-new American light two-seater; but in spite of all that has been said and written pro and anti the Ercoupe and its unconventional controls it remains an ingenious and advanced design and an outstanding contribution towards flying for all.

It makes as near an approach to the foolproofness claimed for it as has ever been achieved. Summarizing, it cannot be spun, it is most reluctant to stall and, with trimmer at the position for take-off and landing, the aircraft assumes the correct speed and attitude for climb or approach (engine on or off as appropriate) without aid. Aimed at a runway, throttle back and left to itself, it would have a reasonable chance of arriving unharmed on the ground. The steerable nosewheel undercarriage, which makes ground handling so simple, is very strong and the wheels have a twelve-inch oleo travel.

Most of these features I checked for myself on a recent flight from Farnborough, made at the invitation of the Ministry of Supply. After the flight I filled in the answers to a quite lengthy questionnaire, and several of these answers are printed and enlarged upon below as appropriate. The Ercoupe concerned carried a certain amount of experimental equipment—incuding Desyns on the control surfaces—and additional instruments, among which was an accelerometer. The automatic recorder which had been mounted high up behind the seats had been removed. The all-up weight allowed is 1,450 lb, the dihedral 7 deg and the wing loading approximately 10 lb/sq ft. A C75-12 Continental engine is so mounted that the thrust line is 3 deg starboard and 5 deg down; this is to reduce torque swing and trim change with alteration of thrust.

By
Wing Cdr. MAURICE A. SMITH, D.F.C.

The flight was in the nature of a refresher, and I purposely made no advance reference to a previous description of flying an early Ercoupe written for the May 15th, 1947, issue of *Flight*. It was thus possible to check my reactions on this previous brief experience. Some slight variations in estimates of nose position and performance then and now may perhaps be attributed to flying solo on the recent occasion and two up originally, and to a number of refinements incorporated in the later Ercoupe. Improvements

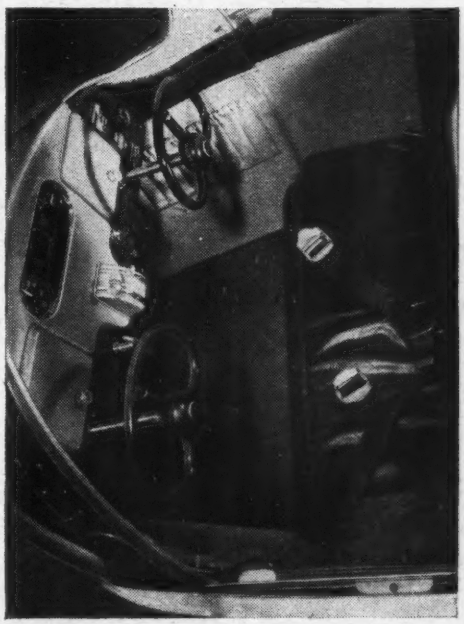


The nosewheel landing gear is particularly sturdy, and the alloy forgings for upper and lower legs can be seen centre and left. Note also the single-disc Goodyear hydraulic brake and the rubber cushion springing (left). All wheels have a 12-inch oleo travel. (Right) The steerable nosewheel is operated by a simple linkage. The ducts around the engine are for carburettor and cabin hot air.

include a larger nosewheel, reinforcement of the rear centre-section spar, and hot and cold air for the cabin. The 1948 Model E also carries two-way radio and has an 85 h.p. Continental engine. The elevator modification on later models was incorporated to eliminate the centre portion, which was operating in disturbed air. A greater up-travel is used to offset the loss of area: Instead of 9 deg (with the aircraft licensed for 1,400 lb) the angular movement is now 20 deg for the same weight. This increased up-travel has enabled the nose to be lifted sooner on take-off and gives a better round-out from the glide for landing.

Reverting to observations on the recent flight, ease of entry (by stepping from the wing over a low cabin-wall on to the seat) is satisfactory for the type, and comfort, room and to-handness of the controls are quite good. The flat-four Continental started readily, and ran smoothly and with the minimum of exhaust noise.

Taxying control is first class; the steering is high-geared like that of a British sports car and the pedal for the brakes is smooth and powerful. View all round is adequate, and the only small criticism is the rather abrupt response to the throttle lever (it was a push-pull knob originally), which is small and did not seem to lend itself easily to fine adjustment in spite of the ratchet quadrant.



The Ercoupe is flown entirely with the aid of a wheel control, and floor space is clear except for a single brake pedal. The throttle and trimmer quadrants are in the centre of the panel.

For take-off one simply lines the Ercoupe up on the runway, puts the trimmer to the take-off mark on its quadrant, and opens up. The steering wheel is used to keep straight, and at any speed over about 50 m.p.h. indicated the aircraft can be pulled off. Left on the ground, it flies off at about 70 m.p.h. There is no appreciable tendency to swing if the take-off is into wind, and the minimum distance against a 10 m.p.h. wind is about 170 yd. Self-fly-off in a light wind, and from a runway, takes around 280 yd.

The climb is left to the pilot, and any speed between 45 and 90 m.p.h. seems to do. The nose position is alarmingly high at low speeds and near maximum rate of climb, and the vision foward is negligible. As the angle is decreased and speed increases the vision improves, but when climbing it is never very good. In fact, until cruising attitude at 100 m.p.h. and about 2,100 r.p.m. is reached the look-out possibilities are below average. A reasonable compromise between climb attitude and rate is attained at full throttle at 75 m.p.h. Both occupants are rather offset relative to the engine cowling, so a line is painted on the top panel to help in keeping on a straight course. A compass is provided, but there are no other flying instruments except A.S.I. and altimeter.

Holding straight flight, level or climbing, in slightly rough air is chiefly a matter of leaving well alone. Any attempt to maintain lateral level may lead to inducing yaw. It is necessary, all the same, to hold the controls central because there is no stability or self-centring of the wheel laterally, (in professional terms, there is a divergent rolling moment) and very little indeed fore and aft. The controls are light, smooth and well harmonized, and medium turns are a pleasure to execute. It is possible to detect a lead in banking before the yaw completes the co-ordination of the turn. Steep turns are not quite such a happy manœuvre, and some restriction on rearward movement of the wheel and the need to hold-off bank can be felt. They are, however, within the Ercoupe's capacity.

Stalling on the Ercoupe is not unlike that of many other light aircraft, but the inboard sections of the wings are induced to stall first and the attainable angle of attack in a normal stall is limited. There is no warning of the approaching stall except nose attitude and air speed, and straight sink occurs while some aileron control is still available. An attempt to spin results in a spiral dive—which is just as well, for spin-recovery action with interconnected elevators and rudders might present problems.

Approaches—and, to a lesser extent, landings—need getting used to. The Ercoupe cannot be side-slipped, and there are no flaps or air brakes. Moreover, to obtain a reasonable forward view an approach speed of about 70 m.p.h. is desirable, although 55 to 60 m.p.h. seems otherwise safe. At the higher speed the approach is very flat, and it is most difficult at first to judge one's touch-down point. For rapid descent—and this would apply to forced and, perhaps, precautionary landings—height can be lost at circuit level by making steep "S" gliding turns. As an alternative, until nearing the ground, it seems safe to "mush" at close to the stalling speed and finally, when approaching the touch-down, to lower the nose and aim for a convenient point on the ground; then, regardless of any speed which may build up, the aircraft can be banged down on to its unusually strong nosewheel landing gear and the brakes applied at once. Speed does not, in fact, build up very rapidly with the nose down.

Employment of the normal precautionary approach technique necessitates, as is often the case, a rather blind, very nose-high attitude, and lowering of the nose (reducing angle of attack) first causes a rapid sink which must be checked by the immediate use of a lot of engine power.

There is a maximum speed limit of 145 m.p.h., and there is little likelihood of this being exceeded in error. In contrast to the light stick-forces for normal flying a fair-sized push is needed to dive. Moreover, wind noise around the canopy above 130 m.p.h. would give warning.

An interesting point remains to be discussed, namely, out-of-wind handling. One thing that needs to be watched on any touch-down is that the steerable nosewheel is straight. This means that when holding-off no bank or rudder can be used to check drift. The makers of the Ercoupe recommend approaching with nose sufficiently into wind to keep the approach path in line with the runway. Touch down is made on the sturdy main wheels first, regardless of drift within reasonable limits, and as the wheels grip they line themselves up and the aircraft twitches into line. The nosewheel is then put down and held down with control wheel well forward. I was able to try a mildly out-of-wind landing and, except for a feeling of clumsiness, this technique worked well enough. I was told that one soon gets used to this procedure, as one does to the one or two other unusualities. However, the real answer surely is to offer self-aligning wheels for those owners who expect to make frequent cross-wind landings.

The cross-wind take-off does not present so much of a problem. Weathercock tendencies are prevented by holding the nosewheel firmly down to get good grip until full flying speed is gained, whereupon the aircraft can be whipped off the ground without danger from side loads

Ercoupe in the Air . . . .

or yaw. It occurs to me, having flown the earlier type of Chrislea Ace, that from the "every man a pilot" point of view the idea of an additional foot accelerator might well be borrowed and incorporaed in aircraft built to fulfil the same function as the Ercoupe. It would heighten the "car-driving" impression and would be most useful on the approach and when taxying. In addition, the foot-brake might also be linked up with a spring-loaded air brake, positioned so that it would have no important effect on trim. This again could be a great aid on the approach to land.

As a postscript, a recent and revealing test flight with the Ercoupe must be recorded. In order further to study the effect of the controls the rudder surfaces were disconnected and locked in their central position, and the aircraft was flown on ailerons and elevators only. According to the Farnborough pilots concerned many of the handling characteristics were found to be virtually unaltered. Attempts to fly a very accurate course in slightly bumpy air, however, produced a rather disconcerting feeling of loss of control. This, it seems, was due to the pronounced delay in the response of the controls and to the pilot's wheel movement getting, in effect, one move ahead of the aircraft.

WEARING R.A.F. ROUNDELS: The Ercoupe at Farnborough, where extensive flying trials have been carried out.

There is no need to offer apologies for renewing impressions of the Ercoupe or for again describing the behaviour of a design which is now quite familiar. It may well be that a light aircraft with many features in common with this one will prove to be the answer to a requirement in private-flying circles over here. That we still have something to learn from it is confirmed by the practical interest which is still being taken by the Ministry of Supply.

The Ercoupe is distributed by Sanders Aviation, Inc., of Riverdale, Maryland.

POINTING THE WAY TO SAFETY

Accident Investigation in Relation to Aircraft Design

"FINDING the cause of an accident may result in the saving of many lives, but this can only be achieved if everybody concerned with the safety of flying, and particularly the designer and manufacturer, will make good use of the information we give them."

This was the conclusion reached by Air Commodore Vernon Brown, Chief Inspector of Accidents at the Ministry of Civil Aviation, in his lecture to the Royal Aeronautical Society last Thursday. A. Cdre. Brown chose to keep to the technical rather than the "pilot-error" aspect, although the two are not always easy to separate. For instance, a breakdown by the pilot in his cockpit drill might not have happened had the cockpit layout been differently designed. He selected from Air Investigation Branch records certain examples of how the technical information obtained has been applied to the rectification of major troubles.

Examples were given of different causes of structural failures in the air, some due to weakness of certain members, but others to aerodynamic faults which brought about loss of control that, in turn, caused structural failure. In all cases remedies were found and there was no repetition of these types of accident.

A large section of A. Cdre. Brown's paper was devoted to the subject of fire—in the air and on the ground. In the early days of the war the equipment and fire-fighting methods were not effective with high-powered engines. The source of ignition was usually the exhaust system, but in some cases inadequately flame-proofed electrical equipment was responsible, such as generators or magnetos. In 1942 an amended anti-fire drill was issued; instead of opening the throttle when a fire started in the engine, the essential first step consisted in feathering the airscrew and stopping the engine before operating the fire extinguisher.

Among the many design changes which have helped to improve safety against fire in the air, the lecturer referred to materials. In place of aluminium engine bulkheads, which had proved inadequate, stainless steel sheet was now accepted as an essential requirement. Steel sheet engine cowlings were recommended, and a number are now being embodied. Fireproofing of fuel and oil pipes was now another essential requirement, and the airscrew feathering mechanism had been suitably protected or moved out of any potential fire zone. Material of high melting point, such as stainless steel, was now required for fire-extinguisher spray piping, and the runs of the pipes themselves had been changed, and additional spray rings and bottles had been installed in most military and civil aircraft.

Insecure unions had been another source of fires in the air. Locking wires of stainless steel had been found generally the most satisfactory, and since their introduction there had been no case of a fire caused by a leaking pipe union which had been wire-locked correctly. The covering of generator brush gear had been improved or entirely enclosed, and a flame-trap vent was now embodied in most magnetos. Shut-off valves for all pipes carrying inflammable fluids were now an essential requirement for multi-engined civil aircraft. All multi-engined aircraft must now have a fire detector which operates a warning light in the pilot's cockpit. Fumes in the cockpit had been the cause of accidents, and wing roots must now be so sealed that no fumes can enter the cockpit in the event of a fire in the air

Badly positioned fuel or oil breather outlets had caused ignition by the exhaust pipes, and all vents and drains from inflammable fluids now had to be so routed as to eliminate this risk. Fuel and oil vents in certain aircraft had also to be repositioned and the exhaust pipes lengthened by 9in.

Free Fuel in Wings

Five cases of fire in the air occurred on a certain type of aircraft, each originating in the neighbourhood of the port or starboard exhaust system, and in four cases the pilot lost control. The fires were attributed to the presence of free fuel inside the wing becoming ignited by the exhaust flame. Several causes of this suggested themselves, but leakage past a faulty or insecure filler cap appeared the most likely. The type of cap used was of plastic material, and the locking lugs would not stand up to hard wear. Remedies were found to be an improved type of filler cap, rearrangement of the oil and fuel vent systems, and enlarged and flush-fitting anti-splash cups around the fuel tank filler necks to prevent fuel from getting into the tank bays in the event of careless refuelling. No further fires of this description occurred.

Turning to the subject of crash fires, A. Cdre. Brown pointed out that the engine exhausts are hot enough to start a fire when highly inflammable liquids come into contact with them, and that in addition there are many electrical circuits which will provide sparks when broken. Combustion is then usually so rapid as to amount almost to an explosion. Such considera-

Pointing the Way to Safety . . . . .

tions led many people to the conclusion that fires of this sort were inevitable, and this fatalistic attitude persisted until the problem was seriously tackled by the Air Investigation Branch in 1944.

As soon as it was possible to reach some conclusions as to how these fires originated, the reseach workers were, for the first time, in a position to consider preventive measures. Some of the requirements were similar to those of fires in the air, but others were peculiar to the crash-fire problem. All large modern aircraft are equipped with extinguisher bottles which discharge automatically on to those parts of the engine installation which are most likely to cause fire.

The discharge from the extinguisher bottles is initiated by an inertia switch set to go off at some pre-arranged value of *g*. It was found at one time that in a high percentage of cases these switches had not tripped, and this was traced to the fact that they had been mounted far back in the fuselage. Whereas the front of the fuselage was subject to very high *g*, the cushioning effect from the collapse of the structure in front reduced deceleration at the rear end to less than the 6*g* at which the switches were set to work. Not until this was realized were the switches placed in the nose or belly, where they would be sensitive to violent impacts other than normal bumps in flying or taxying. Improvements were still being made, and the lecturer expressed the view that the latest development might be a skin-deflection switch.

On the subject of the advantages and disadvantages of integral tanks, bare metal tanks, crashproof metal tanks and crashproof bag tanks, A. Cdre. Brown had little to say except that "it is likely that new design requirements will materialize in due course."

Icing

Carburettor icing had caused trouble in the past, but since stipulation that devices must be fitted which would keep the temperature above that of the outside air, and emergency means for melting any ice that might have formed prior to turning on the heat, no serious accident caused by carburettor icing had occurred to a British registered civil aircraft.

Cockpit drill has become an important feature of modern flying, and A. Cdre. Brown quoted many cases in which insufficient attention had been given by designers to the question of ease of identification and unmistakable operational action. Some years ago a series of simultaneous engine failure in four-engined aircraft were investigated. It was discovered that it was possible, with a low pressure in the reservoir, to start and run the engines with the carburettor fuel cut-off switches in the "cut-off" position. The aircraft could be taken off, but as the air pressure built up, the fuel cut-offs would move to the cut-off position and stop all fuel supply to the engines. The accidents were primarily due to faulty cockpit drill, but the design of the tumbler-type switch was such that it could be left in the wrong position. Since switches of the press-button, spring-return type had been fitted, no further accidents had occurred.

In another case, incorrect cockpit drill associated with poor design led to an accident. The petrol cock was found to be in the "closed" position. The operating handle, under the pilot's seat, was a long one, but on the other side of the cock was a shorter one with a small pointer. The long handle pointed to the "on" position, i.e., the cock was turned off. "This type of accident," A. Cdre. Brown said, "illustrates clearly that careless design in a small and vital control can lead to confusion and incorrect operation by the pilot."

Shortly after a certain new aircraft type had been introduced into the R.A.F. there was an epidemic of accidents caused by pilots retracting undercarriage instead of flaps. During night flying the number of accidents became alarming, and when even experienced instructors made the mistake, it became obvious that there must be bad design features somewhere. The two levers were of the same size, were mounted side by side, and moved in the same sense.

Taking off with locked controls had caused many accidents. In one case the aircraft was found to have taken off with the aileron locking pin in the locked position. This type of accident was remedied by nuisance bars and other foolproof devices. External locks for elevators were another source of accident. Various systems were now in use and were regarded as a normal design requirement.

Changeover from visual to instrument flying had presented difficulties. It was confirmed that at the time of take-off, or on entering cloud, the memory of a set of visual or other sensory impressions conflicted for a short time with the information which the instruments gave the pilot. There was a tendency to ignore the instruments as long as possible, and to rely too long on airfield lighting. One of the chief design features introduced was the pilot's instrument-flying panel.

Some unexplained accidents were ultimately traced to carbon monoxide poisoning of the pilots. Exhaust fumes could find their way into the cockpit through various openings, but closing these and lengthening the exhaust pipes had effected a cure. Percentage checks on aircraft coming off the production line, and CO tests on every prototype aircraft, cured the trouble, and since 1943 there had been no record of an accident from this cause.

Strength of safety belts and fastenings had been increased as a result of experience early in the war, and the question of backward-facing seats for passengers was still receiving much attention.

ELSTREE'S EASTER DISPLAY

AS announced in our "From the Clubs" section some weeks ago, the United Services Flying Club is to hold an Easter Monday display at Elstree, in which the R.A.F. and the U.S.A.F. will participate. Spitfires of No. 604 (County of Middlesex) R.Aux.A.F. Squadron will perform air drill, No. 1 Reserve Flying School and a Zlin sailplane pilot will contribute aerobatics, and there will be parachute drops by a team of three.

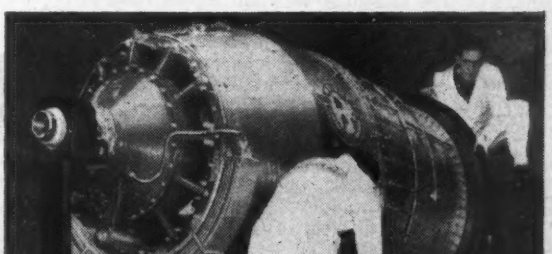
Flying begins at 1100 hours and the programme proper opens at 1430. Proceeds from admission (2s 6d., children half price) will go to the Soldiers' and Airmen's Families Association.

FOR CLEAR VIEWS

SINCE Dr. D. F. Stedman demonstrated his rain-repellent compound in this country some two years ago a small number of kits have been provided for examination and test by Service departments and civil aircraft companies, and it is reported that results to date have been most encouraging. F.C.10 rain-repellent kits are being manufactured by Fiberglas (Canada), Ltd., of Toronto, whose agents in this country are Albright & Wilson, Ltd., 49, Park Lane, London, W.1.

F.C.10 treatment (to which brief reference was made in a recent article on B.E.A.'s helicopter night air-mail services) gives greatly improved vision when flying through rain; it produces a film of negligible thickness, effective on glass or transparent plastic material, and producing no optical distortion. If windows become dirty after treatment they can be polished a number of times before a new application is necessary, and the film is said to be unaffected by petrol, oil or de-icing solutions. One application will normally last for several months, and it may be made in any conditions of humidity at temperatures between −40 and +135 deg F. No special skill is required.

DIFFERENT "TIFFY"



A Curtiss-Wright Typhoon turboprop was experimentally installed last year in the nose of a B-17 Fortress, and some idea of its size and power could be gained from the airscrew diameter and intake and efflux area visible in a photograph published at the time ("Flight," October 17th). Now, as seen above, the unit has been revealed to the public at a New York exhibition. It may be used to power some of America's long-range bombers.

"Flight" photograph.

The largest aircraft yet to arrive at London Airport, Pan American's Boeing Stratocruiser Flying Cloud *is over 110ft long and its fin towers fully 38 ft above the tarmac.*

Double-Decked Clipper

Pan American Demonstrate the First Boeing Stratocruiser in this Country

FOR £375,000 one would expect what our American friends might term "a lot of airplane." Mindful of this outlay, and briefed with due thoroughness by Pan American World Airways, we boarded *Clipper Flying Cloud* at London Airport last week to make the acquaintance of this, the first Boeing Stratocruiser to visit the United Kingdom.

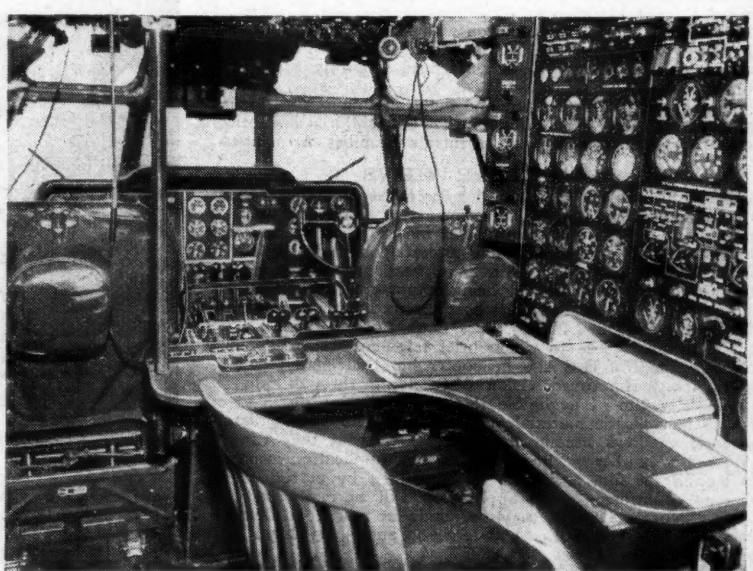
An hour in the air—across to the French coast at 20,000ft, and a return over London—left a firm impression that the Stratocruiser, or Boeing Model 377, is a remarkable aircraft. The tabulated data will support this view.

The physical bulk of the machine is best appreciated not from tarmac level, but from the main cabin on the upper deck. Lounging in one of 53 chairs, one looks down on Yorks, Lancastrians and other frequenters of London Airport, noting, at the same time, the relatively small area of the 141ft wing and the looming masses of nacelles for the 28-cylinder Pratt and Whitney Wasp Major engines, with their high-set thrust-lines.

On his way to the bridge, Captain R. D. Fordyce gave the take-off weight for our brief trip as 125,000 lb—a full 17,500 lb under the present maximum permissible figure. The water-injection system, enabling all of 3,500 h.p. to be taken from each engine, would certainly not be required. At 2,700 r.p.m. and 3,250 h.p. per engine, we were airborne in 22 sec.

Cruising, the noise level seemed somewhat below average, though at full throttle the Pratt and Whitneys left no doubt that they are the most powerful transport engines extant. It had been explained to us that at low speeds, such as in taxying, the square-tipped airscrews, with their four, hollow, pressed-steel blades, would give off a warbling sound, as of chirping birds; this, however, was not audible, due, perhaps, to the pre-take-off chatter of sixty-odd passengers. Tiny holes in the blade tips, to allow drainage of condensed moisture, are responsible for the sibilant note.

Before making the rounds we heard the latest Strato-



"Flight" photograph.

In the extreme bow of the main deck: the Stratocruiser cockpit has all major controls within easy reach of the right hand of the pilot and the left hand of the second pilot. The flight engineer's panel is in the right foreground.

cruiser news from Mr. Harold Mansfield of Boeing. Tests at increased gross weights have just been concluded, he said, and his company hopes to receive authorization for an extra 2,000 lb, raising the take-off wing loading to 84 lb/sq ft. Against this very high value must be set a power loading at maximum take-off output of 10 lb/h.p. The sea-level stalling speed, at 110,000 lb, is 93 m.p.h.

"Boredom," it was observed in the brief-sheet, "is alleviated with unrestricted movement." Surveying the main (upper deck) cabin from the foremost bulkhead, one saw a fairly conventional interior with a greater number of seats, a wider gangway, and more head-room than is usual. The alleviation, we decided, is to be sought by descending the unobtrusive spiral staircase to the lounge, popularly called the cocktail bar, though this alleviating amenity is but one of its features. Here, with cargo holds fore and aft, one may consort in intimate comfort with thirteen fellow-passengers.

"Flight" photograph.

A view which accentuates the bulbous "double-bubble" fuselage of the Stratocruiser and the massive nacelles for the Pratt and Whitney Wasp Major R-4360 turbo-supercharged radials.

A small stateroom, forward of the main cabin, can be booked separately by those wishing to be alone. For the less sensitive remainder, the sleeper version offers 28 upper and lower berths, and five seats.

The galley, fairly described by a P.A.A. publicist as being the size of an average household kitchenette, can serve 75 passengers and a crew of twelve with three complete meals during a 12-hour flight. There are two ovens, each holding 20 meals; four refrigerators; seven six-gallon liquid-containers; and 15 drawers. Coffee is freshly made for each meal. Further stimulation is to be found in 120 miniature (4½-oz) bottles of Scotch, 40 of rye, 30 Manhattans, the same quantity of Martinis, and 25 of gin. The ratio of liquor to literature, in poundage, works out at 67:24.

Voyagers may relish their refreshment content in the knowledge that any pets are safely disposed in one of the pressurized holds, warmed for livestock, or cooled for other cargoes. Freight and mail can be loaded simultaneously through two large doors while passengers are embarking. Galley supplies go abroad through an upper-deck servicing door.

Dressing rooms are located on each side of the central aisle, on the forward upper deck. The ladies' room has twin tables, an upholstered settee, and is mirrored throughout, and the men's room, with three wash-basins, holds five passengers at a time.

The story of the Stratocruiser's development is lengthy and involved. Briefly, Boeing proposed, in June, 1944, a machine of 120,000 lb gross weight, with engines of 2,200 h.p., a fuel capacity of 5,700 U.S. gallons and a cruising speed of 280 m.p.h. Pan American needed more power and more range: accordingly Wasp Majors were specified (as for the B-50 bomber), room for more than 1,200 U.S. gallons of fuel was found in the wing and the weight crept up to 130,000 lb. A point of special interest is that the original Boeing specification recommended the fitting of mechanical engine-superchargers; it was felt that these would prove less complicated for commercial use than the turbos of the Fortress and Superfortress bombers. "Pan Am.," aware of the latest General Electric developments, and the U.S.A.F.'s success with turbo-blowers in long-range bombers (especially in respect of fuel saving at high altitude) decided upon General Electric BH-4 turbos.

Evolution

The next major change in the "spec." was an increase of cargo space from 675 cu ft to 830 cu ft. Yet more fuel was added, and the outcome of Boeing/P.A.A. collaboration was a very different machine from that originally foreseen—one having a payload and gross weight greater, respectively, by 10,000 lb and 15,000 lb; 2,000 U.S. gallons more petrol; and a top speed 60 m.p.h. higher. An extra 5ft on the height of the fin was the principal aerodynamic alteration.

Crew training is proving a major undertaking. Especially valuable has been Pan American's Dehmel Trainer or "flight simulator," embodying a complete replica of the Stratocruiser's cockpit. This £50,000 rig reduces the number of hours needed for practice flights. More than forty different emergency conditions can be reproduced, including undercarriage failure, faulty plugs and carburettor icing.

From such brief conversation as one had with the crew it seemed that they are genuinely enthusiastic about the Stratocruiser's flying qualities. Only the rudder is power-boosted (for low-speed flying) but the controls are light enough. The rudder booster, incidentally, shares with the windscreen wipers, nose-wheel steering and brakes the distinction of being the only hydraulically operated equipment aboard.

During its brief sojourn at London Airport, the Stratocruiser was fuelled by Esso Affiliates with a special grade of 115/145 octane fuel. This is the first time this grade has been used on an international airline working in Europe, and special stocks have been provided by Anglo-American Oil Co. to meet the demands in the British Isles.

BOEING 377 STRATOCRUISER

Four Pratt and Whitney Wasp Major R-4360, 28-cylinder, four-row, radial engines, each delivering 3,500 h.p. at take-off with water injection, and equipped with General Electric BH-4 turbo-superchargers.

DIMENSIONS	
Span	141ft 3in
Length	110ft 4in
Height	38ft 3in
WEIGHTS	
Max. take-off weight	142,500 lb.
Max. landing weight	121,700 lb
Weight empty	83,500 lb
CAPACITIES	
Passenger capacity	61 (75 using lounge)
Fuel capacity	7,630 gall
Total freight capacity (two holds)	830 cu ft
PERFORMANCE	
Cruising speed at 25,000ft	300-340 m.p.h.
Max. rate of climb at sea-level at 142,500 lb gross weight	1100 ft/min
Rate of climb on two engines at sea level at 110,000 lb gross weight	335 ft/min
Stalling speed at sea-level at 110,000 lb gross weight	93 m.p.h.
Service ceiling at 110,000 lb gross weight	33,000ft
Normal operating height	15,000-25,000ft
Max. still-air range (no fuel reserve) with payload of:	
10,500 lb	4,600 miles
20,000 lb	3,550 miles
25,000 lb	3,000 miles

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

"AIRCRAFT AND RUNWAY DESIGN"

The Catapult as a Cure-all

REFERRING to your report (March 31st) of an R.Ae.S. lecture and discussion, under the above title, might I point out that the best means of launching aircraft from either aerodrome or ship seems to have been entirely overlooked by airfield designers, namely, the catapult. This is the safest and least expensive means of launching aircraft, and has been extensively developed by the Royal Navy for use on ships, and was very popular with the Germans for civil-aviation trans-Atlantic flying boats before the war. It is obvious that an airfield equipped with three or four catapults placed in adjoining fields could launch aircraft of any weight and size without the necessity of using the runways at all, thus leaving them clear for landing aircraft. This would immediately double the capacity of the aerodrome, and be much safer generally.

The design of the catapults, which are normally operated by compressed air, would naturally be worked out so as to give a comfortable acceleration to the plane and not be as rapid as those used on battleships.

Mr. Radcliffe's remarks that "the ultimate aim would be to have a grass field airport and employ skid-landings" seems very sensible, because the skid can have a very wide and long bearing surface. The Farman machines in the first world war were fitted with safety skids in case the landing wheels collapsed.

The catapult would cut out all take-off dangers.

J. R. GOULD,
Major.

Westcliff-on-Sea.

[The outstanding objection would be the acceleration, which, however much slowed-down, would still be disconcerting to the ordinary passenger. The German Atlantic experiments were almost entirely concerned with mail-carrying.—ED.]

AMPHIBIANS

Their Advantages in Commercial Operation

THE most excellent article, "Amphibiana," by Allan F. Voak, in *Flight* of March 31st, will be read with interest by all those who are amphibian fans. But no article dealing with the wartime work of amphibians in the Navy would be complete without mention of the Walruses and Geese of 749 Squadron based in Trinidad during the last war.

Short Bros., in their advertisements for the Sealand, have recently been depicting a map of the West Indian Islands which are now to be served by Sealands. During 1944, this run was for a short time undertaken by the Geese of 749 Squadron. Even at that time the problem of inter-island communications was receiving attention, and sundry commissions and advisers were travelling around. Almost any of the pilots in 749 Squadron could have told them that the answer to this problem was the utilization of small amphibians. Now, after five years, it is nice to see the small amphibian, and British at that, coming into its own.

Your correspondent will not object, perhaps, if attention is drawn to a few inaccuracies regarding his remarks on Grumman amphibians. The Widgeon has *not* got a 400 h.p. engine; it is powered by two Ranger engines of about 208 h.p. As regards the Goose, the cruising speed is nothing like 160 knots or miles per hour, for that matter. Cruising speed of the Mallard is in the region of 155 m.p.h. on the clock.

Although all production is earmarked for military use, Grummans make a larger amphibian than the Mallard. This is the Albatross. Built for rough-water operation, it is of rugged construction and looks just like an oversized Mallard.

How right your correspondent is when he states that there is scope for the amphibian! But it cannot be stressed too strongly that, to be successful, the purchase, operation and maintenance of amphibians requires specialized know-how. This cannot be acquired from books or from experience either with boats or with landplanes; it must be acquired the hard way; and, as the operation of amphibians is so limited, all too few people possess this knowledge.

It is the writer's good fortune to be mixed up in the amphibian business, and to have had a nodding acquaintance with purchasing, operation and maintenance problems in several parts of the world, and it is his experience that in fully 90 per cent of the cases where trouble occurs, or where the operation of amphibians has proved disappointing, causes can often be traced to all or some of the following:—

(1) Amphibians unsuitable for the particular job have been purchased.

(2) The aircraft has been suitable for the job, but has been unsuitably fitted out or equipped.

(3) The specialized maintenance so necessary for amphibians has not been carried out.

(4) The use of pilots inexperienced in the particular amphibian operation involved. Any pilot can, of course, be taught how to fly an amphibian. But he cannot be taught beforehand how to deal with the many and diverse situations in which he may find himself when operating an amphibian. This can only come with experience.

NAVIATOR.

Holland.

TURNHOUSE

—and the Resumption of the B.E.A. Service

YOUR paragraph under the heading "Turnhouse Reopens" (March 31st) needs some amendment to avoid misunderstanding. Turnhouse did *not* reopen on April 1st; it has never closed. The fact that British European Airways withdrew their Edinburgh/London service in October last did not mean that Edinburgh (Turnhouse) Airport went out of use. Apart altogether from its function as an R.A.F. training station, it has been used by charter aircraft throughout the winter. In February there were 679 aircraft movements; and on the day of the Scotland versus Ireland Rugby International at Murrayfield there were nine Dakotas, 16 Rapides and two Consuls at Turnhouse—quite an array for a "closed" airport!

The main runway has never been out of use. S.B.A. has *not* "been installed"; it has been in use at Turnhouse for years past. The only change is that additional markers have been installed and the final approach on S.B.A. is now made on a QDM of 131 instead of 311 as formerly.

Commander G. A. Nunneley, O.B.E., who is Airport Commandant of both Edinburgh (Turnhouse) and Aberdeen (Dyce), has as his deputy Mr. F. Tolson, Air Traffic Control Officer i/c.

E. A. ELDERS,
Public Relations Officer, Scottish Division, Ministry of Civil Aviation.

FORTHCOMING EVENTS

April 15th.—Institute of Navigation: "The Influence of Echo Sounding." A. J. Hughes, O.B.E.
April 18th.—Liverpool Chamber of Commerce: Air Display, Speke.
April 18th.—United Services Flying Club: Air Display at Elstree, in aid of Soldiers, Sailors and Airmen's Families Association.
April 19th.—R.Ae.S. (Graduates' and Students' Section): "The Meaning and Measurement of Stability Derivatives," P. Fink, B.E.T.
April 20th.—R.Ae.S. (Portsmouth): "Design for Production," W. Thorn.
April 21st.—Royal Aeronautical Society: "High Lift Devices and their Use," R. R. Duddy, A.F.R.Ae.S.
April 21st.—R.Ae.S. (Gloucester and Cheltenham): Annual General Meeting. Followed by film "Atomic Physics," at Gloucester.
April 26th to 28th.—R.A.F. Golfing Society: Spring Meeting at Berkshire Golf Club, Ascot.
April 27th.—R.Ae.S. (Weybridge): "Present Day Problems in Safety Requirements," W. Tye, O.B.E., B.Sc., F.R.Ae.S.
April 28th.—Royal Aeronautical Society: The 37th Wilbur Wright Lecture. "The Aeronautical Research Scene—Goals, Methods and Accomplishments," Dr. Hugh Dryden, F.R.Ae.S.
April 28th.—R.Ae.S. (Coventry): Annual General Meeting and film.
April 28th.—R.Ae.S. (Manchester): "Rocket Propulsion and Interplanetary Flight," A. V. Cleaver, A.R.Ae.S.
April 29th to May 15th.—Paris Aero Salon.
April 30th.—No. 613 (City of Manchester) Squadron and A. V. Roe Ltd.: Air Display at Woodford airfield.
May 2nd.—R.Ae.S. (Derby): "Lubrication of Aero Gas Turbines," J. G. Dawson, B.Sc., A.F.R.Ae.S.
May 3rd.—R.Ae.S. (Graduates and Students): "Notes on Fighter Development, 1936 1948," J. K. Quill, O.B.E., A.F.C.
May 6th.—Scientific Instrument Manufacturers' Association: Annual Dinner and Dance, May Fair Hotel.
May 7th.—Royal Air Force Rowing Club: Annual Regatta, Reading.
May 8th.—Royal Aeronautical Society: Garden Party.
May 12th.—R.Ae.S. (Graduates' and Students' Section): "Pressure Cabins," D. Cardwell, B.Sc., A.C.G.I., A.F.R.Ae.S.
May 18th.—R.Ae.S. (Weybridge): Branch Members' Junior Prize Lecture.
May 21st.—Northamptonshire Aero Club: 21st Anniversary Air Display.
May 21st.—Aero Golfing Society: Summer meeting and "Flight," Trophy. Ashridge Course.
May 26th and 27th.—National Physical Laboratory: "Open Days" May 26th for representatives of industrial organizations and May 27th for members of university staffs and government departments.

SERVICE AVIATION

WATCHDOG: A Handley Page Halifax patrols near Gibraltar during the lately-completed air-sea exercises. These veteran bombers are now mainly occupied on meteorological flights but civil conversions continue to give good service on the Air Lift

Royal Air Force and Naval Aviation News and Announcements

Observers Tested

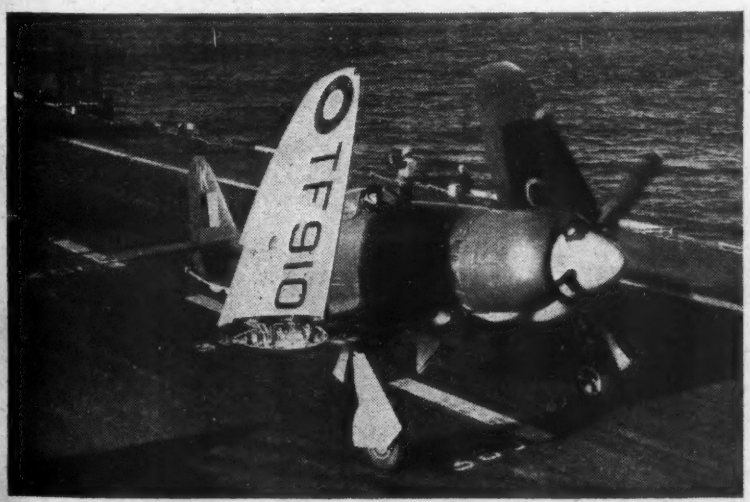
MASTER tests for over 800 operations room personnel of the Royal Observer Corps were held last Sunday. Members gaining over 80 per cent will qualify for a first-class proficiency certificate, and those with 90 marks and over will be classified as Masters and awarded the Master Badge, consisting of a Spitfire printed on cloth and worn on the sleeve.

Award

THE Air Ministry announces that the King has been graciously pleased to approve the posthumous award of the George Cross to Assistant Section Officer Nora Inayat-Khan, W.A.A.F. This officer was the first woman operator to be infiltrated into enemy-occupied France, being landed by a Lysander in June, 1943.

Shortly after her arrival, the Gestapo made mass arrests among the Paris resistance-groups to which she had been detailed but she refused to abandon what had become the principal and most dangerous post in France. After three and a half months she was betrayed, and captured by the Gestapo. Imprisoned at the Gestapo H.Q. in the Avenue Foch, she made two attempts at escape, and after refusing to sign a declaration that she would make no further attempts, she was sent to the Karlsruhe prison camp in Germany in November, 1943, and then to Pforsheim. She had continuously refused to give any information, as to her work or her colleagues, and was finally moved to Dachau on September 12th, 1944. On arrival she was shot.

The citation concludes: "A.S/O. Inayat-Khan displayed the most conspicuous courage, both moral and physical, over a period of more than 12 months." Miss Kahn, who was educated in France, and held degrees in languages and child psychology, came to England in 1939, and joined the W.A.A.F. the following year as a wireless operator. She was transferred to Intelligence duties and granted an honorary commission early in 1943.



FOLDING FURY: With wings tucked-up ready for stowage, a Hawker Sea Fury II taxies along the flight deck of H.M.A.S. Sydney on its way to the lift.

Norwegian Honour

GROUP CAPTAIN MAURICE NEWNHAM, O.B.E., D.F.C., wartime commander of the R.A.F. Parachute Training School, has received the Haakon VII Liberty Cross for "outstanding services rendered to Norway's cause during the war. Under his command were trained many Norwegian secret agents and members of the underground movement of whom G/C. Newnham has written: "They were particularly fine men, and it was a privilege to be able to render some assistance in training them for their heroic tasks." Some of the agents were employed on the epic "heavy-water" mission.

"A" Branch Absorbed

AS from April 5th, the Air Branch of the Royal Navy ceased to exist, and its personnel were absorbed into existing Branches. All former "A" Branch officers are now members of the Execu-

Service Aviation . . . . .

tive Branch, with the exception of air engineer officers, who belong to the Engineering Branch. Ratings will no longer be entered as aircrew. Naval aircrews will in future consist of officer pilots and observers, with either permanent or short-service commissions.

The King's Birthday

AT all R.A.F. Home stations on June 9th, when the King's birthday is officially observed, colour-hoisting parades will be held in the morning, and the Royal Salute will be given instead of the General Salute. The remainder of the day will be a holiday. In overseas commands and B.A.F.O. observance will be at the discretion of His Majesty's chief representative.

R.A.F. Appointments

UNTIL recently Air Officer Commanding the Rhodesian Air Training Group, A.V-M. G. G. Banting, C.B., C.B.E., has taken up a similar appointment with No. 21 Group, Flying Training Command. Before going to Rhodesia, in 1946, he was S.A.S.O., No. 1 (Bomber) Group for nearly a year. From July, 1943, until November, 1945, he commanded the Bomber Station at Lindholme. Born in 1898, he was commissioned in the East Surrey Regiment in 1916, was seconded to the R.F.C. in 1917, and transferred to the R.A.F. on its formation in 1918.

The pilot of the first aircraft to bomb German soil in the recent war, A.V-M. W. E. Staton, C.B., D.S.O., M.C., D.F.C., became Air Officer in Charge of Administration, Technical Training Command, on April 5th. Since November, 1947, he has commanded the Central Bomber Establishment, and was formerly A.O.C. No. 46 (Transport) Group, to which he went in November, 1945, soon after his release from three and a half years as a prisoner of war. He was captured by the Japanese in Java, soon after the fall of Singapore, while serving as S.A.S.O. at Far East Air H.Q. A.V-M. Staton, who is 50, was commissioned in the R.F.C. in 1917.

Appointed to succeed A. Cdre. C. N. H. Bilney, C.B.E., as Director of Technical Training at the Air Ministry is A. Cdre. L. de V. Chisman, D.F.C., formerly Senior Technical Staff Officer at Coastal Command H.Q. A. Cdre. J. Marson, lately Director of Armament at the Air Ministry, is the new S.T.S.O. at Coastal Command.

SURVIVAL SURVEY: Delegates to discussions in London by the International Civil Aviation Organization (African and Indian Ocean Region) inspect an airborne lifeboat slung beneath a Lancaster during a visit to an R.A.F. Survival Unit at Thorney Island.

Reunion

THE third annual reunion dinner of No. 86 Squadron, Coastal Command will be held in London on Saturday, July 2nd. All ranks and all connected with the Squadron are welcomed. Details from M. C. Kay, 33, Springwood Avenue, Allerton, Liverpool, 19.

R.A.F. Swimming Association

AIR COMMODORE G. F. SMYLIE, C.B., D.S.C., has relinquished the chairmanship of the R.A.F. Swimming Association, which he has held for a number of years, and has been succeeded by W/C. C. D. Tomalin, D.F.C., A.F.C., of Flying Training Command H.Q. The association also has a new honorary secretary, S/L. J. H. Iremonger, D.F.C., of Fighter Command H.Q., who succeeds F/L. R. A. Clark.

From 1929 to 1933 A. Cdre. Smylie, then a squadron leader, was one of the R.A.F. team in the Inter-Services Swimming Championships. W/C. Tomalin was in the R.A.F. team in the 1936, 1937 and 1938, 1947 and 1948 Championships, and was Inter-Services diving champion in 1938 and 1947. He represented Great Britain in the Olympic Games diving events in 1936, and he holds the British Empire high diving championship, which he won in 1938. This year's Inter-Services Swimming Championships will be held at the Seymour Hall Swimming Bath, Marylebone, London, on September 14th.

RE-UNITED: Among members of 83 Group Officers Association present at the Londonderry House reunion which took place on April 1st were (left to right) Col. Winkley, G/C. Holmes, and A. Cdre. Sir Harry Broadhurst (President).

R.A.F. Permanent Commissions

SINCE last October, over 100 airmen have been selected for appointment to permanent commission in the R.A.F., subject to medical fitness and, in most cases, to satisfactory completion of a course at an officer cadet training unit. The first list of selections follows:

TECHNICAL BRANCH.

Warrant Officers: F. W. Benson, D. C. Firth, S. E. Gowing, L. Hopkins, T. C. Morris, A. J. Pring.

Flight Sergeants: W. C. G. Budden, B.E.M., G. W. G. Bunyan, J. S. Falvey, J. A. Louis, R. E. Lovelace, A. J. R. Mallett, D. G. M. Moore, H. A. Scarrott, D. A. Thomas, G. E. Trevains, R. A. L. White, D. A. S. Woodbridge, J. J. Worden.

Sergeants: P. R. Browne, E. R. Braun, B.E.M., J. W. Higgins, E. D. Jackson, C. R. Milam, R. L. Mills, H. Penny, T. R. Perry, H. R. A. Snelling, J. R. Tilleard, D. H. R. Weston.

Corporals: K. E. M. Hobson, A. V. H. Palmer, R. E. F. Peck.

SECRETARIAL BRANCH.

Warrant Officers: L. A. Ball, F. Cobb, G. Eccles, S. A. Lucksford, M.B.E., B. A. A. Snook, M.B.E., G. Stringer, J. J. Thomas, E. W. Toogood, W. A. Venables, M.B.E., D. G. Walker.

Flight Sergeants: M. A. Coles, B.E.M., N. George, J. C. Payne, B.E.M., D. H. Ramsbottom, S. Ryan, F. R. Smith, G. F. Tisley, B.E.M.

Sergeants: G. A. Ayres, A. E. Bullivant.

EQUIPMENT BRANCH.

Warrant Officer: B. Day.

Master Signaller: A. S. B. Smith.

R.A.F. REGIMENT.

Sergeant: R. H. Gudgion.

AIRCRAFT CONTROL BRANCH.

Warrant Officer: J. Cunningham Sands.

MARINE BRANCH.

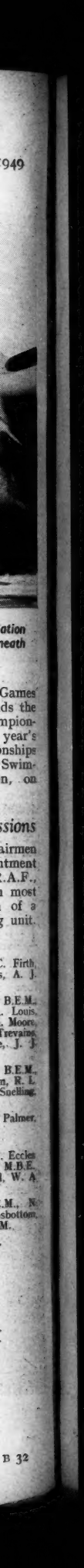
Flight Sergeant: A. J. Lynch.

PROVOST BRANCH.

Flight Sergeant: P. W. J. Darby.

CATERING BRANCH.

Warrant Officer: S. R. Podmore.

PHYSICAL FITNESS BRANCH.

Warrant Officer: F. Willis.